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Transit Oriented Development and Neighborhood Change along the Light Rail System: The Social Equity Impact of the Metro Blue Line in Los Angeles

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Transit Oriented Development and Neighborhood Change along the Light Rail System: The Social Equity Impact of the Metro Blue Line in Los Angeles

by

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Dedication

This report is dedicated to my family in Torrance, California and all my friends who supported me throughout this process.

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Abstract

Transit Oriented Development and Neighborhood Change along the Light Rail System: The Social Equity Impact of the Metro Blue Line in Los Angeles

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The University of Texas at Austin, 2014

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This report examines how the neighborhoods along the Metro Blue line have changed over the past two decades, and reflects on the current emerging issue in Transit oriented development (TOD), which is promoting equitable transit neighborhoods. The primary study area includes the route of the Metro Blue line through Los Angeles County where the most economically disadvantaged and marginalized communities are located in the county.

In order to investigate the impact of the rail line effectively, the concept of Walksheds are used as the units of analysis, which is defined as the area within a half-mile walking distance from the transit station. Focusing on social equity impact of the transit system operation, the comparison analysis between Los Angeles County and the twenty-two Walksheds of each station in the line evaluates the changes in the close-by neighborhoods while also looking at various social demographic indicators that can reflect demographic shifts using decennial Census data of 1990, 2000, and 2010. While looking

at the change through time series data analysis vertically, the performance of each station area is examined horizontally. Therefore, comparative analysis is conducted in four stages to figure out the extent to which the neighborhoods have changed, how rapidly the change occurred and whether the neighborhood change occurred in a positive way or not.

The result from the four comparative analyses indicates that the Metro Blue line did not work as a catalyst for promoting economic opportunity in the region in spite of the initial expectations of its advocates. In the beginning of the rail operation of 1990, the neighborhoods along the rail line were excluded and poverty was widespread in the region. However, even after two decades, the twenty-two Walksheds along the Metro Blue Line still remain as undesirable places to live and marginalized as compared to the rest of the county. Moreover, the neighborhood change in the twenty-two Walksheds is negatively linked to the Walksheds based on the result of the comparative analysis.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Transit oriented development (TOD) is an integrated strategy of land use and transportation that stimulates sustainable prosperity for society by connecting people to housing, transit, and other amenities. In fact, more than 3,000 transit-rich neighborhoods in American metropolitan areas have transit stations.[1] Over a hundred neighborhoods will have transit systems under the current new transit investment plans.[2] Moreover, the geographic distribution of transit systems is continuously changing due to introduction of new transit systems and expansion of existing transit systems. As more demands for transit oriented development occur, more new equity concerns with TOD are raised. If TOD is well planned, it can bring a myriad of social, environmental, and economic benefits to the communities it serves. But if TOD is poorly planned, for example, planning transit lines without considering their core transit riders, it would lead to failure in meeting the future housing demands and push out low income households and local businesses. In other words, TOD may bring unwanted neighborhood change, such as gentrification or displacement.

In an urban setting, public infrastructure investments apparently have great impact on the demography of targeting neighborhoods.[3] Traditionally, transit systems heavily rely on people of color, low income people, and renters. This group is more likely to live in zero car households. Thus, they are regarded as core riders of transit system. However, TOD researchers have long been concerned about patterns of neighborhood change that reduce the diversity of neighborhoods. When TOD occurs, it comes with gentrification of

[1] Pollack, S., Bluestone, B., Billingham, C. (2010) *Maintaining Diversity in America's Transit-Rich Neighborhoods: Tools for Equitable Neighborhood Change*. Boston, MA: Durakis Center for Urban and Regional Policy.
[2] Ibid
[3] Ibid

the adjacent area and it is directly related to displacement of disadvantaged groups, such as the core riders. While gentrification can be a positive or destructive form of neighborhood change, displacement is a pattern of neighborhood change in which original residents are forced to move out involuntarily because they cannot afford to stay in the gentrified neighborhoods.[4] Looking at these neighborhood changes from the viewpoint of equitable transit oriented development, displacing low income residents and people of color might be an environmental justice concern. If TOD is necessary to promote better and healthier life of neighborhoods, every person in the neighborhood should benefit from the transit investment. Therefore, if new transit system begins, understanding the neighborhoods and core riders of transit system should precede implementing TOD strategies. If the existing transit system is to be expanded, investigation of the existing neighborhoods' change over time after the operation of transit system should be performed in order to determine if the area experienced displacement or gentrification.

Many studies have focused on property values around TOD areas or economic achievement with TOD. However, recent studies about TOD have been moving towards building equitable transit oriented communities that ensure equal opportunity and accessibility to quality transportation choices.[5] Some remarkable studies about equitable transit oriented development conducted demographic analysis in order to track the neighborhood change along the existing transit systems.[6] Throughout these studies, researchers found that the pattern of change, whether attributed to gentrification, displacement, replacement, or turnover of the region, raises serious environmental justice issues. Moreover, understanding the neighborhood change and key drivers of these changes

[4] Metropolitan Area Planning Council (2014) *The dimensions of displacement: Baseline Data for Managing Neighborhood Change in Somerville's Green Line Corridor*.
[5] Pollack, S., Bluestone, B., Billingham, C. (2010) *Maintaining Diversity in America's Transit-Rich Neighborhoods: Tools for Equitable Neighborhood Change*. Boston, MA: Durakis Center for Urban and Regional Policy.
[6] Metropolitan Area Planning Council (2014) *The dimensions of displacement: Baseline Data for Managing Neighborhood Change in Somerville's Green Line Corridor*.

is important to prioritize the degree of policy interventions that can resolve the neighborhood change progress which is accompanied by negative aspects of gentrification.

The Blue Line in the Los Angeles area was built twenty-three years ago on existing rail lines over twenty-two miles between downtown Los Angeles and Long Beach. With twenty-two stations, the line passes through the most neglected and disadvantaged communities in Los Angeles County and also through large segments of abandoned industrial lands.[7] The Blue Line was supposed to promote economic development in the areas adjacent to the rail line. However, the communities in proximity still remain marginalized. Many researchers point out that the region's disproportionate lack of economic development despite light rail transit is due to a lack of integrated approach that encompasses the need of core riders and private sector's diverse interests.[8] A number of abandoned lands along the Blue Line still wait for the reinvestment opportunity even now.

This professional report aims to examine how the neighborhoods along the Blue line have changed over two decades. I will focus on social equity impacts after the transit system operation. In brief, I will evaluate the close neighborhoods' change looking at some indicators that can reflect the demographic shifts using decennial Census data 1990, 2000, and 2010. While looking at change through time series data analysis vertically, the performance of each station area will be examined horizontally. In this professional report, seven social demographic indicators were chosen and utilized for the comparison analysis. By using social demographic indicators, I will figure out a sense of the characteristics of each neighborhood along the Metro Blue line and how the neighborhoods are different from Los Angeles County. Second, based on the social demographic changes, in percentage, in Los Angeles County between the decades 1990 to 2000, and 2000 to 2010 and the Walksheds changes, within the same time frame, I expect to determine where

[7] Loukaitou-Sideris A. and Banerjee T. (2000) "The Blue line Blues: Why The Vision of Transit Village May Not Materialize Despite Impressive Growth in Transit Ridership", *Journal of Urban Design*, Vol. 5, pp.101-125

[8] Ibid

investments are necessary or which neighborhoods have already experienced displacement, gentrification, or unwanted demographic shifts.

Since precedent studies are limited to looking at the 1990 and 2000 Census data and they focused on economic impacts on the areas, I believe that my study will be significantly different from the other studies.

The following questions will be addressed in this report:

- Is there a significant neighborhood change in terms of the social equity characteristics along the Blue Line corridor?

- If a change exists, has the line played a role as a catalyst in fostering positive neighborhood change in the inner city station areas over time?

- If each station performance varies, which station area has changed the most rapidly over time?

- Is there any station area that experienced gentrification or displacement?

Chapter 2: Literature Review

Traditionally, planners, policymakers, and transportation scholars have agreed that transit investment has continuously and significantly changed the surrounding neighborhood. Although early studies about transit oriented development were focused on urban formations and land use pattern adjacent to transit stations, recent emerging concerns emphasize on equity issues such as gentrification and displacement that accompanied the transit system. As shown in many precedent case studies, most cities that invested in transit systems have experienced considerable demographic, socio-economic changes in their neighborhoods.

First, I want to look at the definition of equitable Transit Oriented Development (TOD) and current social equity issues in TOD throughout literature review. Then, I will look at several case studies to grasp the idea of how transit oriented development changed the focus on social equity impacts in nearby neighborhoods. Last, in order to justify the importance of research on the Metro Blue Line in the Los Angeles area, I will investigate transit and TOD in the Los Angeles area and any major preceding research about the Metro Blue Line.

2.1 TRANSIT ORIENTED DEVELOPMENT

Transit oriented development (TOD) is generally concerned with land use and transportation strategy focused on place-based solutions which can connect people to housing, transit, and other key amenities.[9] Based on remarkable enthusiasm for inducing equitable neighborhood change in adjacent neighborhoods of transit system among

[9] Carmen Rojas, Aug 07, 2012, Equitable TOD: Meeting the Needs of People & Places, http://www.livingcities.org/blog/?id=68 (Accessed February 17, 2014)

planners, designers, and activists, the images of TOD reflect new urbanist visions, which is viewing TOD as a way of "smart growth."[10] According to Bernick and Cervero, the design and layout of TOD is focused on pedestrian-friendly environments, so it can be often described as a "transit village", where mixed-use communities serving by the transit stop. Therefore, TOD can be expressed as an alternative way of dwelling in close proximity to transit, in a pedestrian oriented and high density atmosphere.

While the goals of TOD are broad, they can be represented by two major goals at the regional level and local level.[11] At the regional level, TOD can become a strong magnet force for investment that can support the self-sustainability of the region over time by increasing access to economic opportunity, lower housing and transportation costs, and better public health. At the local level, TOD accelerates neighborhood change for the target neighborhood's regional competitiveness through transportation and development investments by maximizing the benefits from transit hubs.

2.2 SOCIAL EQUITY ISSUES IN TOD: GENTRIFICATION AND DISPLACEMENT

According to the report, *Maintaining Diversity in America's Transit-Rich Neighborhoods*, Americans are using transit more and are interested in living in transit-rich neighborhoods, much more now than ever before.[12] As more demands for TOD occurs, more new equity concerns are raised because transit investment apparently changes the near neighborhood in various ways, either adversely or positively. In fact, the most

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[10] Calthorpe, P. and Associates (1990) *Design Guidelines / Final Public Review Draft for Sacramento County Planning Community Development Department*.
Bernick, M. and Cervero, R. (1997) *Transit villages in the 21st Century*. New York: McGraw Hill.

[11] Center for Transit Oriented Development (2010) *Creating Successful Transit-Oriented Districts in Los Angeles: A Citywide Toolkit for Achieving Regional Goals*.

[12] Pollack, S., Bluestone, B., Billingham, C. (2010) *Maintaining Diversity in America's Transit-Rich Neighborhoods: Tools for Equitable Neighborhood Change.* Boston, MA: Durakis Center for Urban and Regional Policy.

common and predominant pattern of neighborhood changes from TOD are increased housing costs and replacement of the existing residents with higher income groups. These concerns about gentrification and displacement associated with TOD are generally regarded as issues of equity.

Historically, neighborhoods adjacent to light rail transit systems have been composed of people of color, low-income households and renters.[13] Because of these demographic trends, transit-rich neighborhoods are more racially diverse, poorer, and contain a higher ratio of rental housing than other neighborhoods. Therefore, if transit investment occurs, the households in the region may face a higher risk of displacement and relocation to the other regions with limited transportation options. In order to achieve an equitable transit development, considering core riders who often use public transportation is critical for the success of a transit system.[14] A majority of preceding research points out that there is a lack of consideration of these demographic groups in the existing urban context when planning TOD.[15]

The main issues in social equity in TOD can be represented as gentrification and displacement. While the terms distinguishing between gentrification and displacement are often used interchangeably, recent research tries to distinguish between these terms.

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[13] Ibid

[14] Metropolitan Area Planning Council (2014) *The dimensions of displacement: Baseline Data for Managing Neighborhood Change in Somerville's Green Line Corridor*.

[15] Loukaitou-Sideris A. and Banerjee T. (2000) "The Blue line Blues: Why The Vision of Transit Village May Not Materialize Despite Impressive Growth in Transit Ridership", *Journal of Urban Design*, Vol. 5, pp.101-125

> *Gentrification is a pattern of neighborhood change in which a previously low-income neighborhood experiences reinvestment and revitalization, accompanied by increasing home values and/or rents. Gentrification, while frequently controversial, can be either good or bad for a neighborhood, depending on who benefits from the reinvestment and revitalization. Gentrification may or may not be associated with displacement, a pattern of change in which current residents are involuntarily forced to move out because they cannot afford to stay in the gentrified neighborhood.*[16]

Following the definition of gentrification above, sometimes gentrification accompanies displacement, but displacement cannot occur solely as a mechanism of the driving force of the demographic change in neighborhoods. Agreement among many researchers is that displacement should be viewed as a part of inclusive phenomenon of migration.[17] According to the report, *The dimensions of displacement*, displacement is a kind of housing occupancy change in migration followed by turnover and replacement.[18] In particular, displacement is residents moving out under pressure to do so exceeding the natural turnover rate because of unaffordability and unavailability of housing. At this point, in-migrants tend to have higher income that can afford the gentrified communities.

According to one recent research that looked at demographic change in gentrifying census tracts between 1990 and 2000 Census, the process of gentrification was not just from out-migration in population of low-income and uneducated black people in the region, but it is also combined with in-migration by white college graduates and high income population.[19] This study supports the thought that the pattern of neighborhood change, whether caused by displacement, replacement or combination of in migration process, the

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[16] Pollack, S., Bluestone, B., Billingham, C. (2010) *Maintaining Diversity in America's Transit-Rich Neighborhoods: Tools for Equitable Neighborhood Change*. Boston, MA: Durakis Center for Urban and Regional Policy.

[17] Ibid

[18] Metropolitan Area Planning Council (2014) *The dimensions of displacement: Baseline Data for Managing Neighborhood Change in Somerville's Green Line Corridor*.

[19] McKinnish, T., Walsh, R. and White, K. (2008) *Who gentrifies low-income neighborhoods?* Cambridge, MA: National Bureau of Economic Research (Working Paper 14026)

result shows the same in that the gentrified neighborhood is likely to be filled up with higher-income population. However, regardless of ultimate cause of this pattern of neighborhood change, this phenomenon that's seen all over the transit rich neighborhood raises serious equity concerns.

2.3 CASE STUDIES IN NEIGHBORHOOD CHANGE AND TOD

In the report of *Maintaining Diversity in America's Transit-Rich Neighborhoods: Tools for Equitable Neighborhood Change*, they analyzed socioeconomic change in 42 neighborhoods in 12 metropolitan areas served by rail transit between 1990 and 2000 Census in three stages. First, they looked at percentage change data for each station and its corresponding MSA in order to compare each variable. The difference between percentage changes is regarded to check if there has been significant change in a demographic factor that might have been caused due to a transit stop. The second stage of analysis in this report is re-analyzing the particular data that has shown large difference (more than 20%) between the percentage change in the station neighborhood and that in the corresponding MSA. Third, they categorized 42 stations into three groups based on transit types in order to see whether the neighborhood change depends on transit types or not.

According to the result of the report, many of the transit rich neighborhoods changed, followed by the pattern of change in their larger metropolitan areas. However, when focused on particular neighborhoods having large percentage change differences compared to MSA, many transit rich neighborhoods experienced gentrification due to the rising housing value, influx of wealthier population and increased vehicle ownerships of the region. Moreover, they found that neighborhoods with a high ratio of renters are more likely to respond to gentrification. Despite strong evidence of gentrification, such as housing values, incomes, and rents, it is hard to conclude if this gentrification was from involuntary displacement of former residents. Even though gentrification can be a positive

form or a destructive form of neighborhood change, the report points out that higher income population and automobile-owning households are less likely to use transit for commuting. In other words, a new transit development and reinvestment brought unintended consequences by taking transit options from those groups most likely to use public transit and by giving a favor to groups that are more likely to drive. This conclusion calls attention to the equity issue of TOD because when we look at the result, it clearly shows that there is a lack of understanding of neighborhoods' contexts and inclusive planning for core transit riders that are mostly people of color and low income. While planners often state that transit oriented development should support ridership, considering and embracing the transit oriented neighborhoods into the TOD process is necessary in order for successful TOD because regular transit users can revitalize the neighborhoods surrounding transit stops more vigorously.

There is a more recent significant case study looking for the dimensions of displacement prepared by the Metropolitan Area Planning Council.[20] The study looked at baseline data in order to manage neighborhood change in Somerville's Green Line corridor due to its extension. The analysis examines the future effects on current residents of Somerville in terms of displacement risks for lower-income residents along the light rail line. In order to determine the displacement risk, they looked at the data of rent increases, condominium conversions, the loss of subsidizing units, and property tax increases.

Notable points of this report are the unit of analysis chosen, "Walkshed" and the data used in the analysis, "PUMS." According to the report, the Walkshed is the area within a half-mile walking distance of a transit station. It is not a just circular buffer with a half-mile radius, but an irregular shape whose contour follows the location of pedestrian routes. I believe that using the concept of Walkshed is more reasonable for analysis in TOD than

[20] Metropolitan Area Planning Council (2014) *The dimensions of displacement: Baseline Data for Managing Neighborhood Change in Somerville's Green Line Corridor*.

the traditional approach which is using circular buffer as the impact area of TOD because originally TOD seeks a pedestrian- friendly environment.

Interestingly, they used the Public Use Microdata Samples (PUMS) in order to examine the migration pattern reflecting turnover, replacement or displacement. Using data from PUMS, they were able to study the composition of in-migration and out-migration in Somerville categorized by income, race, and nativity. By looking at the PUMS data, they found several remarkable points. First, in contrast with the conventional wisdom of gentrification, people with high income age group are more likely to move out and young people with low-income group are more likely to move in. Moreover, considering the net change, Asians and Black people are increasing, while White people are moving out, and Hispanics are close to zero net change. Last, in-migration and out-migration between native and foreign born have a constant rate. Based on these results, they concluded that the migration patterns in Somerville can be attributed to turnover, but if net out-migration of a particular group over time exceeds the current level, it can be regarded as displacement.

The other case study, *Bay Area Rapid Transit System*, analyzed the demographic and land use changes over the twenty years in Bay areas after BART operation began.[21] In this study, Cervero examined the various socio-economic changes over time on local and sub-regional levels by setting a six-mile buffer around a station along BART. The noticeable point from this study is that BART has a significant influence on downtown San Francisco due to its remarkably rapid increase in office development around BART stations. Moreover, population growth in San Francisco rapidly increased around stations more than areas without stations, while suburban areas showed a result that is contrary to that of San Francisco. Based on the result of the study, Cervero concludes that BART has played a significant role in growth of downtown in the Bay areas. However, suburban areas with BART did not seem to benefit from the light rail transit over time. This study is meaningful for my research since the Metro Blue line passes through inner cities and

[21] Cervero, R. and Landis, J. (1997) "Twenty Years of the Bay Area Rapid Transit System: Land Use and Development Impacts." *Transportation Research Part A-Policy and Practice* 31(4) pp.309-333

suburbs of the greater Los Angeles areas and most areas traversed by the Metro Blue Line have been away from the development, like the result of this study.

According to Kahn's article, *Gentrification Trends in New Transit Oriented Communities: Evidence from Fourteen Cities that Expanded and Built Light Rail Systems*, the communities with Walk and Ride stations tend to become more susceptible to gentrification than communities with Park and Ride stations based on studying fourteen cities that invested in the light rail system.[22] While not all cities receiving light rail transit experienced gentrification, Boston and Washington D.C. have gentrified the most. Moreover, this study confirms that light rail transit plays a role as a poverty magnet because regular transit user tends to be low-income and has less car ownership.

Kahn found that the housing price increased drastically when housing demands and zoning fail to be balanced. Moreover, an increase in property value leads to less population growth. Also, he addressed that college graduate is a key indicator to determine whether gentrification occurs or not, because based on his research, while walk and ride station areas have 5.1% more college educated residents, college educated adults in a neighborhood area with park and ride station decreased by 1.9%. Another key point is that gentrification feeds on itself - improved park and leisure area leads to improved school and safer neighborhoods. Therefore, neighborhoods close to walk and ride stations have experienced more gentrification than those in proximity to park and ride stations. To sum up, this research firmly states that gentrification relies on the type of light rail transit system.

The last case study about neighborhood change and TOD is *The Changing Socio-Economic Structures of Dallas*.[23] Ishikawa and Tsutsumi examine the socioeconomic

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[22] Kahn, M. (2007) "Gentrification Trends in New Transit Oriented Communities: Evidence from 14 Cities that Expanded and Built Rail Systems." *Real Estate Economics* 35(2): 155

[23] Ishikawa, Y. and Tsutsumi, J. (2006) "The Changing Socio-Economic Structure of Dallas, U.S." *Applied GIS* 2(2) 10.1

changes that took place in Dallas between 1990 and 2000 (DART operation began in 1996). They found that the introduction of DART changed the shape of the city's original spatial structure where the development predominantly occurred in the northern suburbs of Dallas. Even though the southern neighborhoods still remained at low levels of population and employment growth, some areas adjacent to DART stations showed an increase of population with a high influx of Hispanic population. However, the northern suburbs did not experience any increase in population or employment.

The most important point drawn from the data in this study is that light rail system in Dallas changed the social fabric of the neighborhoods in central city. After DART operation, social segregation among income groups decreased because suburban residents started to come back to the central city and people of color and low income residents in the central city had increased opportunities to commute to suburban areas. While the spatial segregation between high income residents in Northern Dallas and low income residents in Southern Dallas still exists, DART plays a role in diluting the concentration of segregation of Dallas.

2.4 TRANSIT AND TOD (TRANSIT ORIENTED DISTRICTS) IN LOS ANGELES

Metro Rail is the rapid transit rail system consisting of six separate lines, including two subway lines (the Red and Purple Lines) and four light rail lines (the Blue, Green, Gold and Expo lines) serving 80 stations in the Los Angeles County, California, area. It connects with the Metro Line, bus rapid transit system (the Orange Line and Silver Line) and also with the Metrolink commuter rail systems.[24] The Metro Rail system began operations in 1990 with the opening of the Blue Line light rail system which was completed in its existing form a year later in 1991. The Red Line opened soon after, in January 1993, followed by

[24] Facts at a Glance, LA Metro, http://www.metro.net/news/facts-glance/, (Accessed June 15, 2014)

the Green Line in 1995 and, most recently, the Gold Line in 2003. The Red Line was expanded three times in the late 1990s through 2000, expanding twice to the northwest from Downtown to North Hollywood, and then with the Purple Line spur of the Red Line extending into Koreatown. The Gold Line was expanded in late 2009 through the commercial and suburban areas of Pasadena.[25]

Figure 1. LA Metro Rail System Map[26]

[25] Ibid

[26] Maps & Timetable, LA Metro, http://www.metro.net/riding/maps/, (Accessed July 5, 2014)

Statistics: ***Estimates, as of May 2014***	**Metro Blue Line**	**Metro Red/Purple Lines**	**Metro Green Line**	**Metro Gold Line**	**Metro Orange Line**	**Metro Silver Line**	**Metro Expo Line**
Opened	1990	1993 MacArthur Park, 1993; Wilshire/ Western, 1996; Hollywood, 1999; North Hollywood, 2000	1995	2003 Eastside Extension, 2009	2005 Extension from Canoga Park to Chatsworth, 2012	2009 South Bay and El Monte via Downtown Los Angeles	2012
Average Weekday Boardings	87,206	149,456	40,587	41,839	25,873	13,411	31,031
Average Saturday Boardings	56,113	99,993	23,888	28,219	16,922	5,896	23,752
Average Sunday / Holiday Boardings	45,075	75,773	18,021	24,336	12,976	4,439	14,597
Total Annual Boardings FY2014	25.1million	45.8 million	12.5 million	10.7 million	6.9 million	6.5 million	7.9 million
Miles	22	17.4	20	19.7	18	n/a	8.6
Type	Light Rail	Subway/Sub way	Light Rail	Light Rail	Transitway	Transitway	Light Rail
Stations	22 (inc. 3 shared)	16 (inc. 6 shared)	14 (inc. 1 shared)	21 (inc. 1 shared)	18 n/a	10 n/a	10 (inc. 2 shared)
Number of rail cars/buses on route	69	104	34	43	30	41	18
Construction Cost	$877 million	$4.5 billion	$718 million	$1.8 billion	$484 million	$587 million	$930 million

Table 1. LA Metro Rail and Transitways[27]

[27] Facts at a Glance, LA Metro, http://www.metro.net/news/facts-glance/, (Accessed June 15, 2014)

While the Los Angeles County works hard to activate transit system more than ever, many neighborhoods with transit system still remain dilapidated and economically disadvantaged. Since transit infrastructure alone cannot support the economic vitality as a whole, Los Angeles County implemented the Transit Oriented Districts (TOD) as a vision of new regional movement.[28] In the recent project performed by Center for Transit-Oriented Development (CTOD), they developed a variety of tools measuring the stations' performance with station area information including ridership, car ownership, and neighborhood change.[29] CTOD expects that this toolkit will provide a bigger picture of the relationship between stations and neighborhoods.

In order to evaluate station area performance, CTOD used CTOD National TOD Database which includes 4,200 existing and planned transit stations and 1990 and 2000 US Census data manipulated to a half-mile radius buffer around each station. For equity impact assessment, they used indictors that can reflect the displacement risks. In terms of the vulnerability of local residents to displacement, indicators of median household income, percent of renter households, and share of expiring affordable units are used for analysis. Moreover, in terms of neighborhood change, they used indicators about change in educational attainment, change in family structure, change in median household income, and change in income diversity. According to the result of evaluation of each station, Los Angeles's station areas have lower income neighborhoods than the rest of areas as well as many station areas have a high share of renter-occupied households.

The interesting points of this project is that they categorized stations into three types which may require significant intervention. Following the types of rapid demographic change, they divided the types of intervention as increased risk of displacement,

[28] Center for Transit Oriented Development (2010) *Creating Successful Transit-Oriented Districts in Los Angeles: A Citywide Toolkit for Achieving Regional Goals*.
[29] Ibid

disinvesting, and polarizing. According to the result, a number of stations in Blue Line require high priority of intervention due to disinvestment.

2.5 METRO BLUE LINE: THE GHETTO BLUE

Historically, the Blue Line was the very first segment of Los Angeles County's rail system. The line was built in 1990 and it passes through South Central Los Angeles along 21 miles between downtown Los Angeles and Long Beach. South Central Los Angeles is usually regarded as being full of economically disadvantaged and neglected neighborhoods because of abandonment and deterioration of surrounding physical infrastructure. The Blue line might be the solution for revitalization of depressed and marginalized communities along the corridor, but the adjacent neighborhoods remain undeveloped despite its high ridership levels.

	June 2014	**June 2013**	**June 2012**
Average Weekday Boardings	87,206	86,485	89,523
Average Saturday Boardings	56,113	61,314	59,718
Average Sunday and Holiday Boardings	45,075	48,396	47,599
Total Calendar Month Boardings	**2,281,143**	**2,278,247**	**2,368,959**

Table 2. Ridership of Metro Blue Line over Time [30]

[30] Ridership Statistics, LA Metro, http://www.metro.net/news/ridership-statistics/, (Accessed July 2, 2014)

According to Schweitzer's article, the blue line gives us some lessons for transit reinvestment as a revitalization strategy.[31] She addresses a cautionary tale of three things about blue line. First, land market does not move as transit advocates and builders please. Also, classism in TOD design concepts made the development of the Blue Line become undesirable. Last, there was a lack of understanding between the community context and the willingness to achieve consensus for direction of community development. She emphasized that community engagement and social policy should be accompanied by infrastructure investment in order to ensure successful transit oriented development.

In the article, *The Blue Line Blues: Why the Vision of Transit Village May Not Materialize despite Impressive Growth in Transit Ridership*, Loukaitou-Sideris and Banerjee pointed out that the major reason of failure of Metro Blue Line is a lack of consideration of understanding neighborhoods' characteristics.[32] When the Blue Line was at the planning stage, the transportation planners utilized existing unused tracks of early rail system in order to minimize the cost of construction. While planning the new light rail system along abandoned rail corridor, the planners did not consider the desirable land use and population concentration, and socio-economic factors that could boost economic vitality along the corridor. In this study, they conducted a Delphi survey to assess the problems and prospects of TODs around inner city stations such as the Blue Line. Through the result of that survey, they concluded that there should be coordination of land use and transportation, collaboration with all range of players involved in the development process, active community involvement and sound economic incentives that can promote economic development adjacent to transit stations.

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[31] Lisa Schweitzer (2012) *Transit-Oriented Classism in Los Angeles, A Look at the Ghetto Blue*, http://www.plannersnetwork.org/2012/07/summer-2012-los-angeles-what-future-for-the-city-of-the-future/ (Accessed April 20, 2014)

[32] Loukaitou-Sideris A. and Banerjee T. (2000) "The Blue line Blues: Why The Vision of Transit Village May Not Materialize Despite Impressive Growth in Transit Ridership", *Journal of Urban Design*, Vol. 5, pp.101-125

Chapter 3: Research Methods

3.1 Research Question

This report examines the social equity impacts of the existing light rail system and the Metro Blue Line in Los Angeles over time. Reflecting the recent emerging interest in equitable transit-oriented development, it is meaningful to find out how neighborhoods close to the stations changed as time passed. Setting the start point at 1990, comparison analysis will be employed to observe the pattern of change in the region by decennial data, followed by 2000 and 2010. Additionally, through a comparison of station performance by decennial data, I will examine which neighborhood has rapidly changed and which has not. Assessing the Metro Blue Line experience over the adjacent neighborhoods is instructive in determining the effects of the light rail transit on demographic changes in the region. If there is a remarkable neighborhood change in terms of social equity planning viewpoint, it can be helpful to figure out why neighborhoods in proximity to the Metro Blue Line still remain marginalized compared to the other areas in Los Angeles County.

The following questions will be addressed in this report:

- Is there a significant neighborhood change in terms of the social equity characteristics along the Blue Line corridor?
- If a change exists, has the line played a role as a catalyst in fostering positive neighborhood change in the inner city station areas over time?
- If each station performance varies, which station area has changed the most rapidly over time?
- Is there any station area that experienced gentrification or displacement?

3.2 STUDY AREA

The primary study area includes the route of the Metro Blue line through Los Angeles County. Starting from Downtown Los Angeles as the northern part of the Blue Line, the study area encompasses all the way down to City of Long Beach to the Downtown Long Beach station. The Blue Line passes through South Los Angeles neighborhoods, a section of unincorporated communities and census-designated places in Los Angeles County, and City of Compton.[33] It must be noted that cities of Vernon, Huntington Park, Lynwood, and Carson surround the Blue Line. In order to conduct comparative analysis of neighborhood change indicators, Los Angeles County has also been chosen for study area as a base line of the indicator of analysis.

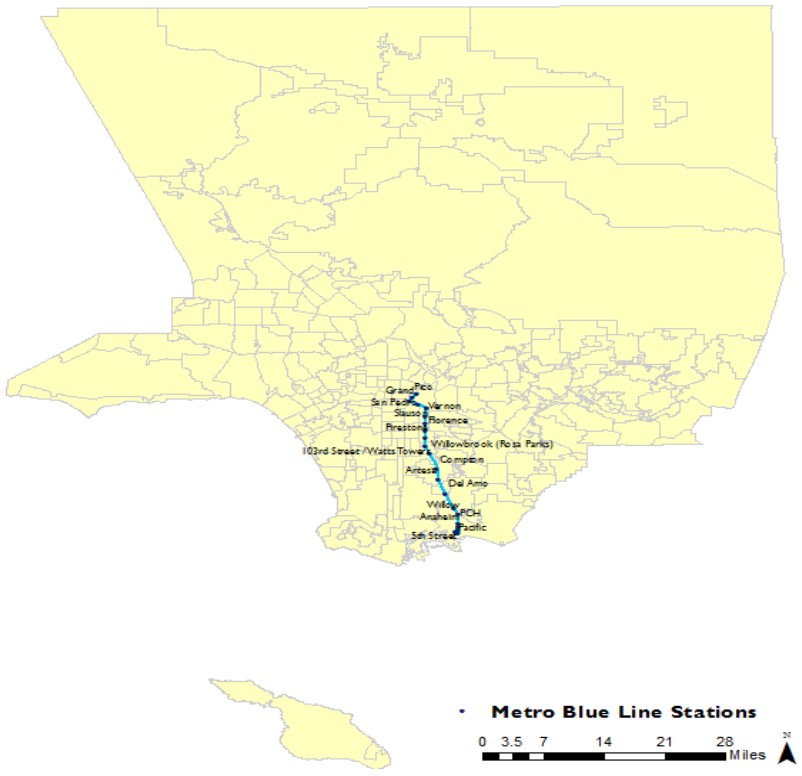

Figure 2. Study Area: Los Angeles County with the Blue Line

[33] Blue Line (Los Angeles Metro), Wikipedia, http://en.wikipedia.org/wiki/Blue_Line_(Los_Angeles_Metro), (Accessed July 8, 2014)

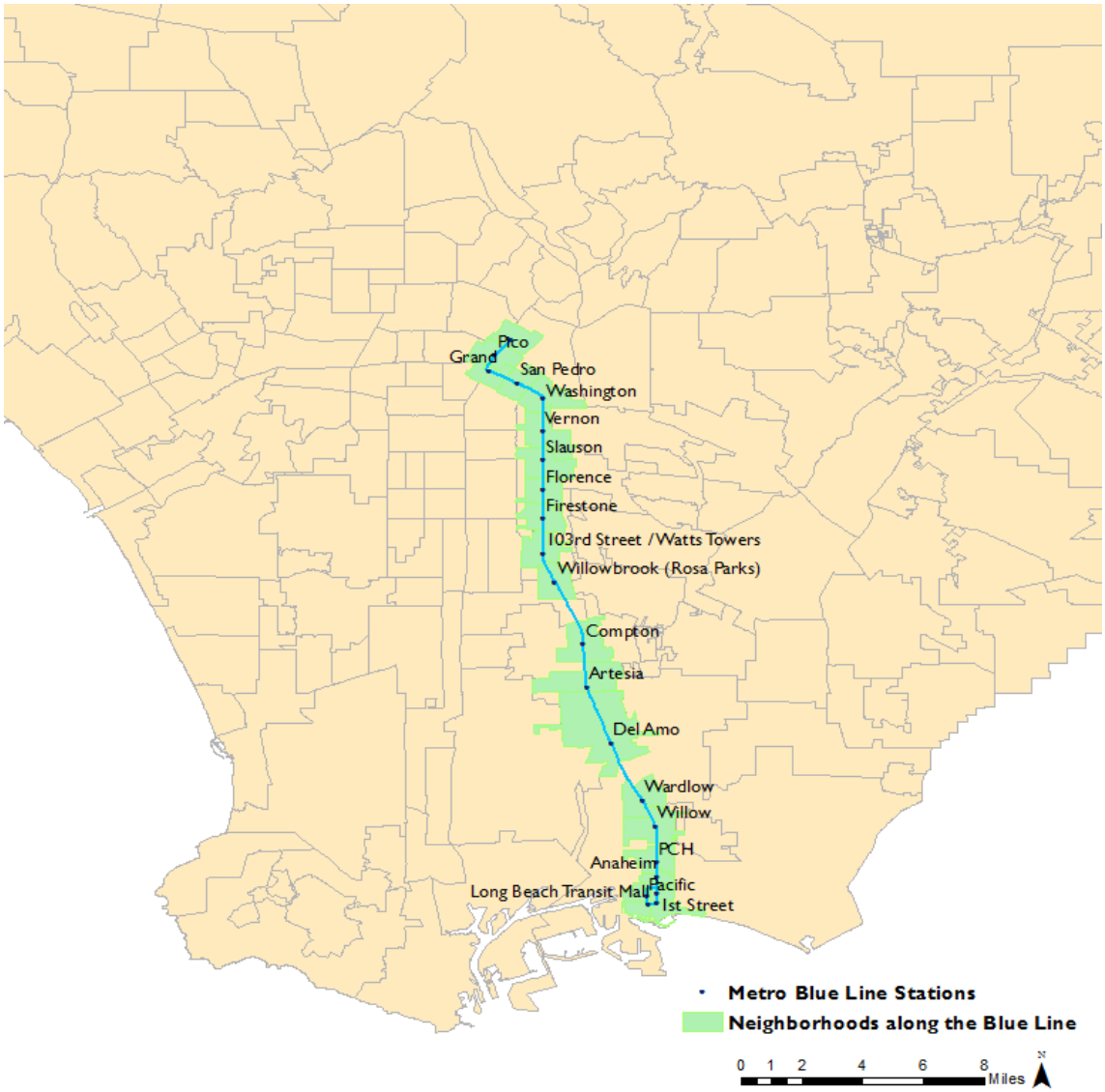

Figure 3. Study Area: Neighborhoods along the Blue Line

3.3 UNIT OF ANALYSIS

In this study, analysis was done at the Census block group level which is appropriate for data viewed across the study area more specifically. Block groups are statistical subdivisions of the Census tracts and normally contain between 600 and 3,000

people per one block group.[34] While census tracts are generally used in the analysis of neighborhood change, block group levels were chosen for this study because of the preciseness of data when data is aggregated to each station's "Walkshed."

The concept of Walkshed was used in the recent study, *The Dimensions of Displacement* by Metropolitan Area Planning Council.[35] They defined Walkshed as the area within a half-mile walking distance of the transit station. This is shaped by sidewalks considering the pedestrian walkways. According to the research titled "The Walking Distance Research" by TOD Committee, walking distance is defined as less than a half-mile, which involves a less than 10 minute-walk.[36] Moreover, most experts agree that a half mile by a half mile square area with the station at the core is the primary "sphere of influence" of a transit system. Also, the maximum distance that most people are willing to walk to reach a destination is regarded as a half-mile.[37] In addition, to reflect the definition of TOD which prioritizes the pedestrian friendly environment as the primary goal, I applied this concept to my research so that I could seek more significant and precise analysis about neighborhood change along the Blue Line.

Each Walkshed related to a station in the Blue Line was made by considering half-mile walking distances and named after the station's name. Since some of stations are located within one mile, I assigned the block group in the Walkshed to the station that is closer between two stations to avoid overlapping between Walksheds. Twenty-two Walksheds are produced and used in this analysis. As a group, twenty-two Walksheds' data is aggregated when we look at the neighborhood change by Los Angeles County versus the surrounding neighborhoods influenced. For individual Walksheds, the data of each

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[34] Geographic Terms and Concepts - Block Groups, US Census Bureau, https://www.census.gov/geo/reference/gtc/gtc_bg.html, (Accessed July 10, 2014)

[35] Metropolitan Area Planning Council (2014) *The dimensions of displacement: Baseline Data for Managing Neighborhood Change in Somerville's Green Line Corridor*.

[36] Planning Commission TOD Committee. *Walking Distance Research*, http://www.fairfaxcounty.gov/planning/tod_docs/walking_distance_abstracts.pdf, (Accessed June 2, 2014)

[37] Loukaitou-Sideris A. and Banerjee T. (2000) "The Blue line Blues: Why The Vision of Transit Village May Not Materialize Despite Impressive Growth in Transit Ridership", *Journal of Urban Design*, Vol. 5, pp.101-125

walkshed is compared to assess the performance and degree of change of each station horizontally.

Figure 4. Walksheds by the Metro Blue Line in Los Angeles

3.4 INDICATORS

In order to examine how the neighborhoods along the Metro Blue Line have changed over a period of two decades (1990 to 2000, and 2000 to 2010), seven social demographic indicators were chosen and utilized for the comparison analysis. First, using social demographic indicators, I tried to discover the social demographic status of neighborhoods close to the Metro Blue rail line. This data provides a sense of the characteristics of each neighborhood and how the neighborhoods are different from Los Angeles County. Moreover, looking at the social demographic indicators over time can offer a sense of the vulnerability of local residents to displacement as market changes draw new households to the area over time.[38] In other words, a comparison analysis can tell us whether there is a displacement or gentrification in the selected neighborhoods.

The following social demographic indicators were selected:

Family Structure

In order to see the family structure of various Walksheds neighborhoods, I utilized the family household ratio as an indicator. Through looking at this indicator, we can see what household type is dominant in each of the neighborhoods. In this report, family household ratio means the average proportion of family households per block group.

Housing Units

The housing units indicator is calculated by total housing units per block group. Through investigating the average housing units per block group, this indicator gives us an idea of the residential density of the area.

Median Household Income

[38] Center for Transit Oriented Development (2010) *Creating Successful Transit-Oriented Districts in Los Angeles: A Citywide Toolkit for Achieving Regional Goals*.

In this report, median household income is calculated by the average median household income per block group. This indicator gives a sense of which neighborhoods are comprised of low income groups or high income groups. Looking at the indicator over time will tell us which neighborhoods experienced gentrification or displacement.

Percent of Renter Households

This indicator investigates the tenure status of the area. It can be interpreted as the vulnerability of local residents to displacement since renters are more easily moved out due to the pressure of rapid rise in rent when gentrification occurs.

Percent of College Graduates

This indicator shows us how the neighborhoods are composed of certain population groups. Percentage of college graduates might tell us the relationship to the median household income, since those with higher education are usually higher paid.

In-Migration

In-Migration is calculated by the average number of people per block group that lived in a different MSA or lived abroad last year. This is an indicator of the average influx of population in the area.

Housing Affordability

In order to determine how affordable housing is in the area, average estimates of median gross rent as a percentage of household income per block group is used in this report. Looking at the change in this indicator tells us how housing affordability has changed over time by comparing the average estimate to that of Los Angeles County.

Second, based on the social demographic changes, in percentage, in Los Angeles County between the decades 1990 to 2000, and 2000 to 2010 and the Walksheds changes, within the same time frame, I calculate the changes to the neighborhoods close to the Metro Blue Line stations. By comparing the percentage change data over that time, I expect to see the speed of change in social demographic indicators of the neighborhoods, as well as the degree of change of neighborhoods along the Metro Blue Line. Moreover, evaluating neighborhood change can be useful to determine where investments are necessary or which neighborhoods have already experienced displacement, gentrification, or unwanted demographic shifts.

Percent Change in Family Structure

This indicator tells us how the neighborhoods have changed in terms of household type. If there is significant percentage change in this indicator, that means the neighborhoods have experienced displacement.

Percent Change in Housing Units

Since this indicator measures residential density per block group, percentage change in housing units can demonstrate whether residential development has occurred around the area.

Percent Change in Median Household Income

Change in median household income indicates whether a particular neighborhood experienced gentrification or not. If percent change in this indicator is high, that means the residents of neighborhoods changed rapidly, replacing low income households who left the neighborhoods because the area became unaffordable.

Percent change in Renter Households

This indicator also gives a sense of change in various Walksheds areas by showing changes in housing affordability. When this indicator goes up, that can be interpreted as a neighborhood becoming more vulnerable to displacement.

Percent change in College Graduates

Through change in this indicator, we can get an idea of how the composition of the population has changed over time. Percentage change in this indicator shows how rapidly the neighborhood changed over time.

Percent change in In-Migration

Since in-migration means the average influx of population per block group, percent change in this indicator implies that the region is still an attractive area in which to live compared to other regions. If the percentage change is positive, in-migration is growing so the region is still competitive and desirable compared to other areas.

Percent change in Housing Affordability

Through the percentage change in this indicator, we can explore how housing affordability changed in the area over time. If displacement or gentrification occurred, the percent change in median gross rent would lower.

3.5 DATA

To evaluate neighborhood change indicators, data was gathered from US Census Bureau and NHGIS data finder prepared by Minnesota Population Center.[39] Since the 1990 Census data was unavailable on the US Bureau website, it was obtained by NHGIS data finder.[40] The 2000 Census, 2010 Census, and 2006-2010 American Community Survey 5-Year Data were downloaded from the American Fact Finder website.[41] Downloaded data includes household type, total housing units, geographical mobility in the past year for current residence, education level of the population 25 years and older, median household income, median gross rent as a percentage of household income, and tenure. Below, the table summarizes each of the data sources and metrics for this report.

Indicator	Year	Parameter	Universe	Source
Family Structure (Family Household Ratio)	1990	Household Type	Households	1990 Census: STF 1 - 100% Data
	2000			2000 Census: SF 1b - 100% Data
	2010			2010 Census: SF 1a

Table 3. Data Summary

[39] Minnesota Population Center, National Historical Geographic Information System: Version 2.0., https://www.nhgis.org/, (Accessed June 16, 2014)

[40] NHGIS data finder, https://data2.nhgis.org/main, (Accessed June 17, 2014)

[41] American Fact Finder, http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t, (Accessed June 17, 2014)

Table 3, Continued

Indicator	Year	Parameter	Universe	Source
Housing Units	1990	Housing Units	Housing units	1990 Census: STF 1 - 100% Data
	2000			2000 Census: SF 1b - 100% Data
	2010			2010 Census: SF 1a
Median Household Income	1990	Median Household Income in 1989	Households	1990 Census: STF 3 - Sample-Based Data
	2000	Median Household Income in 1999		2000 Census: SF 3b - Sample-Based Data
	2010	Median Household Income in the Past 12 Months		2010 American Community Survey: 5-Year Data [2006-2010]
Percent of Renter Households	1990	Tenure	Occupied housing units	1990 Census: STF 1 - 100% Data
	2000	Occupied Housing Units by Tenure		2000 Census: SF 1b - 100% Data
	2010	Tenure		2010 American Community Survey: 5-Year Data [2006-2010]

Table 3, Continued

Indicator	Year	Parameter	Universe	Source
Percent of College Graduates	1990	Educational Attainment	Persons 25 years and over	1990 Census: STF 3 - Sample-Based Data
	2000	Population 25 Years and Over by Sex by Educational Attainment		2000 Census: SF 3b - Sample-Based Data
	2010	Sex by Educational Attainment for the Population 25 Years and Over		2010 American Community Survey: 5-Year Data [2006-2010]
In-Migration	1990	Residence in 1985 -- MSA/PMSA Level	Persons 5 years and over	1990 Census: STF 3 - Sample-Based Data
	2000	Population 5 Years and Over by Residence in 2000 - MSA/PMSA Level by Residence in 1995	Persons 5 Years and Over	2000 Census: SF 1b - 100% Data
	2010	Geographical Mobility in the Past Year for Current Residence—MSA level	Population 1 year and over living in a MSA	2010 American Community Survey: 5-Year Data [2006-2010]

Table 3, Continued

Indicator	Year	Parameter	Universe	Source
Housing Affordability	1990	Median Gross Rent as a Percentage of Household Income in 1989	Specified renter-occupied housing units paying cash rent	1990 Census: STF 3 - Sample-Based Data
	2000	Median Gross Rent as a Percentage of Household Income in 1999		2000 Census: SF 3b - Sample-Based Data
	2010	Median Gross Rent as a Percentage of Household Income in the Past 12 Months		2010 American Community Survey: 5-Year Data [2006-2010]

Through the utilization of this Census information, various sets of data were created. These sets of data were used for assessing the neighborhood change along the Blue Line as compared to the changes in Los Angeles County. In the first stage, data set of different years were compiled and compared, such as of 1990, 2000, and 2010, was created to explore and compare socio-demographic characteristics of Walksheds and Los Angeles County. In the second part, calculating the percent change between years is done to see the rate of change in Walksheds.

1990 Los Angeles County Social Demographics
2000 Los Angeles County Social Demographics
2010 Los Angeles County Social Demographics
Los Angeles County Percent Change between 1990-2000
Los Angeles County Percent Change between 2000-2010
1990 Walksheds Social Demographics
2000 Walksheds Social Demographics
2010 Walksheds Social Demographics
Walksheds Percent Change between 1990-2000
Walksheds Percent Change between 2000-2010

Table 4. Sets of Data Used in the Analysis

Charts and maps were also created based on various sets of data. ESRI ArcGIS 10.1 was used for the overlay along with spatial analysis tools such as clip, merge, dissolve, buffer, and intersect. Spatial statistics were also used to calculate the indicator measures used for each Walkshed, which is a designated unit of analysis in this research.

Charts	Charts comparing average estimates of each indicator between Los Angeles County and twenty-two Walksheds in 1990
	Charts comparing average estimates of each indicator between Los Angeles County and twenty-two Walksheds in 2000
	Charts comparing average estimates of each indicator between Los Angeles County and twenty-two Walksheds in 2010
	Charts comparing average estimates of each indicator among twenty-two Walksheds in 1990

Table 5. Charts and Maps That Are Generated for the Analysis

Table 5. Continued

Charts	Charts comparing average estimates of each indicator among twenty-two Walksheds in 2000
	Charts comparing average estimates of each indicator among twenty-two Walksheds in 2010
	Charts comparing percent changes in each indicator in Los Angeles County and twenty-two Walksheds between 1990-2000
	Charts comparing percent changes in each indicator in Los Angeles County and twenty-two Walksheds between 2000-2010
	Charts comparing percent changes in each indicator among twenty-two Walksheds between 1990-2000
	Charts comparing percent changes in each indicator among twenty-two Walksheds between 2000-2010
Maps	A map illustrating twenty-two Walksheds along the Metro Blue Line
	Maps comparing average estimates of each indicator among twenty-two Walksheds in 1990
	Maps comparing average estimates of each indicator among twenty-two Walksheds in 2000
	Maps comparing average estimates of each indicator among twenty-two Walksheds in 2010
	Maps comparing percent changes in each indicator among twenty-two Walksheds between 1990-2000
	Maps comparing percent changes in each indicator among twenty-two Walksheds between 2000-2010

3.6 Analysis Method

The research approach in this report is a comparative analysis between Los Angeles County and selected neighborhoods adjacent to the Metro Blue Line. Comparative analysis

is conducted in four stages to figure out to what extent the neighborhoods changed and how rapidly the change occurred.

First, the report observed the average basic demographic data of 1990, 2000 and 2010 of Los Angeles County and twenty-two Walksheds, which are the near neighborhoods of the Metro Blue Line. Average estimates of household type, total housing units, in-migration, education attainment of the population (25 years and older), median household income, median gross rent as a percentage of household income, and tenure status are calculated by region, such as Los Angeles County and its twenty-two Walksheds. Based on the average estimates of the data, comparative analysis by every decade gives a broad picture of the status and change of the adjacent neighborhood areas regarding whether the neighborhood is below average as according to the social demographic indicators of Los Angeles County, or is above average.

Second, focusing on the twenty-two Walksheds, average estimates of each social demographic indicator are examined to assess the performance of each station on the basis of time. Comparison of data from the twenty-two Walksheds for the years 1990, 2000, and 2010 can tell us which station received advantages from the Metro Blue Line through greater opportunities in terms of upward economic mobility and which Walkshed neighborhoods have still remained economically disadvantaged.

Third, based on the social demographic changes, in percentage in Los Angeles County between decades (1990 – 2000, 2000 – 2010) and the Walksheds changes, in percentage, between decades (1990 – 2000, 2000 – 2010), I calculate the changes to the neighborhoods close to the stations. Moreover, by comparing the percentage change data on the basis of time, I expect to see the speed of change in social demographic indicators of the neighborhoods, as well as the degree of change of neighborhoods along the Metro Blue Line.

Last, based on percentage change data of social demographic indicator of each Walkshed on the basis of time, I have looked at how rapidly the neighborhoods in the

proximity to the station have changed. Through the comparison of the performance of each station area, it was determined which neighborhood experienced rapid change and which neighborhood did not. Moreover, evaluating neighborhood change by station will help to figure out which neighborhood experienced displacement, gentrification or other unwanted demographic shifts.

Chapter 4: Findings

This findings section includes the results of four sections of comparison analysis, using social demographic indicators and percentage changes in those indicators. The first and second sections present results from a comparative analysis that is based on the average estimates of household type, total housing units, in-migration, education attainment of the population (25 years and older), median household income, median gross rent as a percentage of household income, and tenure status. After comparing average estimates of indicators for each decade and region, comparing Los Angeles County versus twenty-two Walksheds areas, the comparison analysis was conducted based on the social demographic changes, in percentage, in both Los Angeles County and the Walksheds between decades (1990 – 2000 and 2000 – 2010). The results will conclude with tables and maps comparing Los Angeles County and twenty-two Walksheds based on these indicators. Moreover, for both analysis steps, the performance of each station area is examined horizontally while looking at the change through time series data analysis vertically. Therefore, this section is organized in following manner:

1. Comparison analysis of social demographic indicators between Los Angeles County and twenty-two Walksheds by each decade.

2. Comparison analysis of social demographic indicators among twenty-two Walksheds by each decade.

3. Comparison analysis of percent change in social demographic indicators between Los Angeles County and twenty-two Walksheds between decades (1990-2000, 2000-2010).

4. Comparison analysis of percent change in social demographic indicators among twenty-two Walksheds between decades (1990-2000, 2000-2010).

4.1 Comparison analysis of social demographic indicators between Los Angeles County and twenty-two Walksheds by each decade

The comparison analysis results are investigated from two different viewpoints: first, time, and second, by each individual indicator. Chronologically, the data start in 1990 when the Metro Blue Line began its operation, the comparison analysis, based on 2000 and 2010 data follows. After looking at social demographic indicator by decades, each average estimate of indicators is presented by each indicator in order to observe the trend of changes in the various indicators.

4.1.1. Snapshots by decades

The average estimates of each indicator are sorted by decade, from 1990 to 2010. In 1990, the Walksheds areas along the Metro Blue line are regarded as marginalized and economically disadvantaged neighborhoods according to the data in the below table. Compared to the average of Los Angeles County, the neighborhoods close to the station areas have more non-family households, fewer housing units, significantly lower median household income, a higher percentage of renter households, a remarkably low percentage of college graduates, lower in-migration, and a higher median gross rent as a percentage of household income. It is very complex to interpret these indicators since they are interdependent. So, this investigation reflects an intricate problem of the selected neighborhoods. For example: the reason why median household income is much lower in the selected neighborhoods than the average of Los Angeles County could be reflecting that they have a higher uneducated population than the county average. Moreover, the reason why the Walksheds area has low housing affordability might come from the fewer housing units and lower median household income when compared to the entire county. Taken together, the neighborhoods along the Metro Blue Line are not desirable to live or remain in, with low economic opportunity and are economically unstable in 1990.

	Los Angeles County	Walksheds
Family Structure (Family Household Ratio)	0.70	0.65
Housing Units	527.93	390.26
Median Household Income	$38,057	$20,389
Percent of Renter Households	47.86%	67.84%
Percent of College Graduates	28.44%	14.39%
In-Migration	718.04	595.04
Median Gross Rent as a Percentage of Household Income (Housing Affordability)	27.67%	29.10%

Table 6. Average Estimates of Each Indicator between Los Angeles County and Walksheds Areas in 1990. Indicators: *Family Structure* average family household ratio per block group, *Housing Units* total housing units per block group (residential density), *Median Household Income* average median household income per block group, *Percent of Renter Households* average percent of renter households per block group, *Percent of College Graduates* average percent of college graduates per block group, *In-Migration* average number of people that lived in a different MSA or lived abroad last year per block group, *Median Gross Rent as a Percentage of Household Income* average median gross rent as a percentage of household income per block group.

In 2000, the Walksheds area shows slightly better opportunity than 1990, as shown by the average estimates in the indicators.

	Los Angeles County	Walksheds
Family Structure (Family Household Ratio)	0.72	0.70
Housing Units	515.56	400.61
Median Household Income	$48,440	$27,036
Percent of Renter Households	47.52%	68.56%
Percent of College Graduates	30.25%	14.17%
In-Migration	664.82	583.72
Median Gross Rent as a Percentage of Household Income (Housing Affordability)	28.25%	28.76%

Table 7. Average Estimates of Each Indicator between Los Angeles County and Walksheds in 2000

While the indicators of family structure, median gross rent as a percentage of household income, and in-migration became similar to the average of Los Angeles County, the rest of the indicators show that they still have a low affordability of housing and low investments to stabilize the neighborhoods. In particular, median household income and percent of college graduate remain significantly lower than that of Los Angeles County. Moreover, due to the soaring percentage of renter households, the data can be interpreted as the neighborhoods along the Metro Blue Line becoming more vulnerable to displacement.

	Los Angeles County	Walksheds
Family Structure (Family Household Ratio)	0.71	0.67
Housing Units	536.75	539.21
Median Household Income	$63,420	$37,424
Percent of Renter Households	48.19%	68.71%
Percent of College Graduates	35.03%	19.60%
In-Migration	198.36	235.38
Median Gross Rent as a Percentage of Household Income (Housing Affordability)	34.93%	36.70%

Table 8. Average Estimates of Each Indicator between Los Angeles County and Walksheds in 2010

According to comparison of the average estimates of each indicator between Los Angeles County and Walksheds area, the Walksheds area remarkably outperforms the county in terms of the indicators of housing units and in-migration in 2010. However, the neighborhoods still have significantly low median household income and percentage of college graduates, as well as a very high percentage of renter households. Moreover, median gross rent as a percentage of household income became higher than the average of Los Angeles County.

In conclusion, the selected neighborhoods close to the stations experienced active demographic change due to in-migration, but this in-migration might be interpreted as a

lack of investment in the region or replacement of local residents, rather than gentrification, because the characteristics of the neighborhoods still show a low affordability of housing.

4.1.2. Overview by indicators

In this section, the results from the comparison analysis of social demographic indicators between Los Angeles County and twenty-two Walksheds areas is re-categorized according to each indicator.

Family Structure (Family Household Ratio)

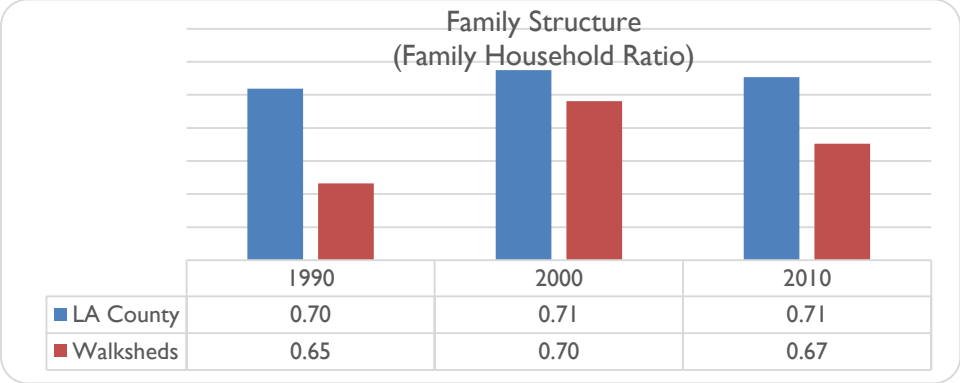

Figure 5. Graph Comparing Family Structure between LA County and Walksheds

As seen in the above bar graph, while the family household ratios have been stable in the Los Angeles County, the Walksheds area experienced nominal changes in family structure during the time period studied. However, overall, there has been no significant change in family structure in either Los Angeles County or Walksheds. Both have similar family structures as indicated in the above results.

Housing Units

Since the initiation of the Blue Line, the Walksheds area has received more housing units. At the beginning, in 1990, housing units were fewer than the average of the county. However, after two decades, housing units are more than the county average.

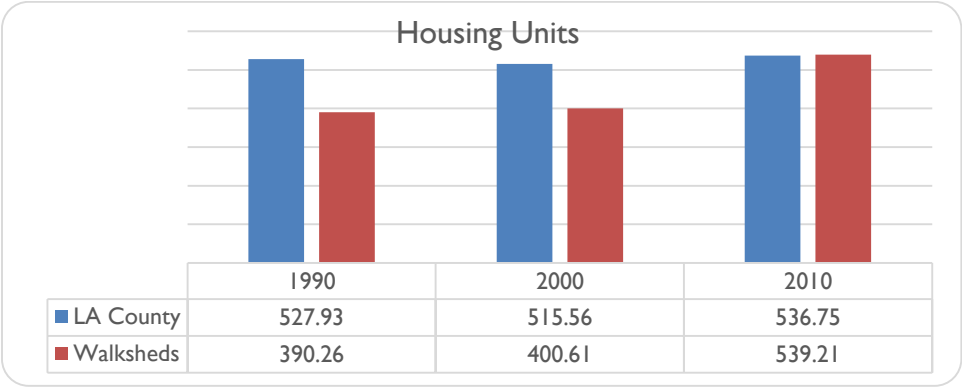

Figure 6. Graph Comparing Housing Units between LA County and Walksheds

Median Household Income

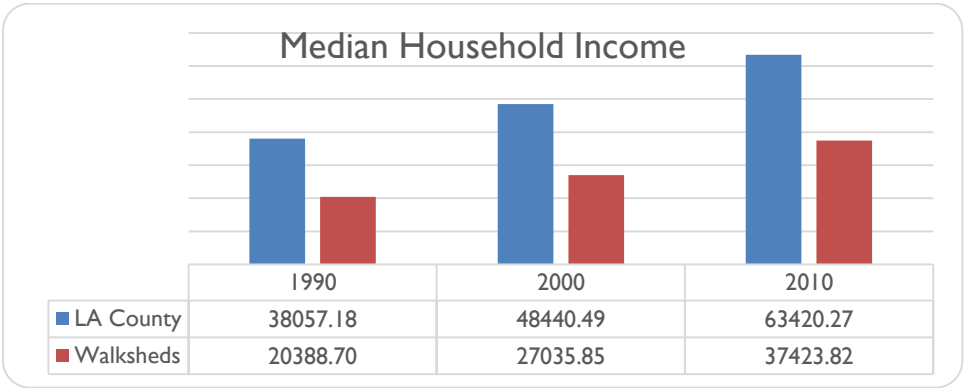

Figure 7. Graph Comparing Median Household Income between LA County and Walksheds

As the median household income has increased over time in Los Angeles County, the Walksheds area has also increased. However, the rate of increase in income in the Walksheds area has not kept pace with that of Los Angeles County. During the time period studied, the median household income in Walksheds area has remained approximately half of the average of the county. This reflects the fact that people in the neighborhoods still have low income jobs.

Percentage of Renter Households

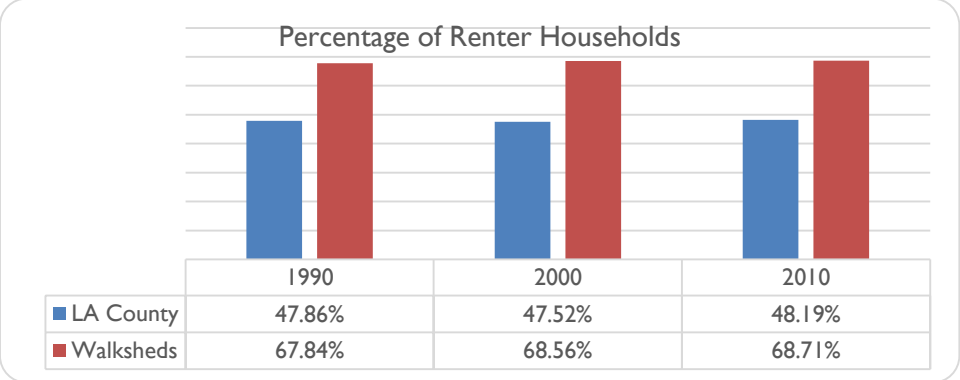

Figure 8. Graph Comparing Percent of Renter Households between LA County and Walksheds area

As seen in the above graph, the share of renter households did not have significant change over time in either the Los Angeles County or Walksheds. However, over time, the Walksheds area has maintained a higher share of renters among households than the county as a whole.

Percentage of College Graduates

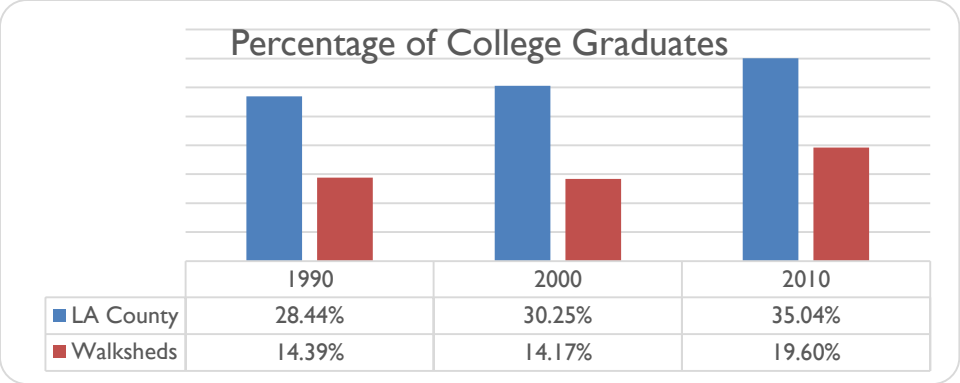

Figure 9. Graph Comparing Percent of College Graduates between LA County and Walksheds

As the percentage of college graduates is increasing in Los Angeles County, the Walksheds area also has a growing share of the percent college graduates. However, the increasing rate of college graduates in the Walksheds area is much smaller than the average of the county. In 2000, the share of residents who are college graduates decreased in the Walksheds area, while the percentage of college graduates in the county has steadily increased. Even though the share of the college graduates increased in 2010 in the Walksheds area, the percentage still remains half of the average percentage of Los Angeles County.

In-Migration

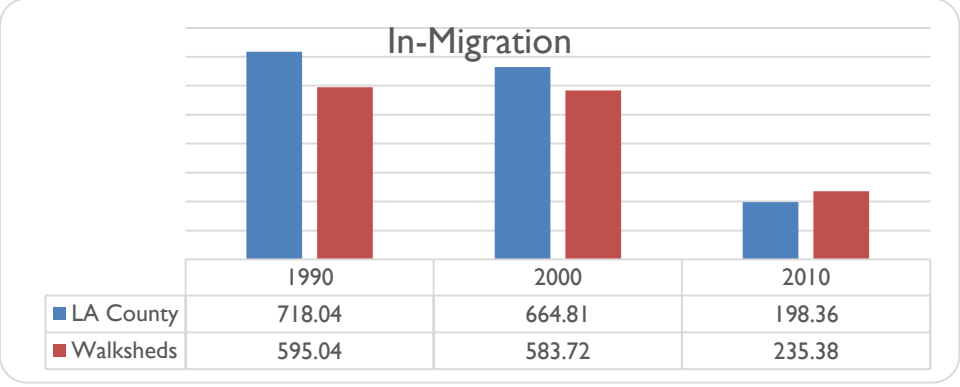

Figure 10. Graph Comparing In-Migration between LA County and Walksheds

Unlike other indicators, population migrating in both Los Angeles County and Walksheds area has decreased. In 1990 and 2000, the decreased rate of in-migration was slow. By 2010 the in-migrating people rapidly decreased. However, in 2010 the Walksheds area has more in-migration than the county. This can be interpreted as a positive sign that the Walkshed area has more growth potential.

Median Gross Rent as a Percentage of Household Income (Housing Affordability)

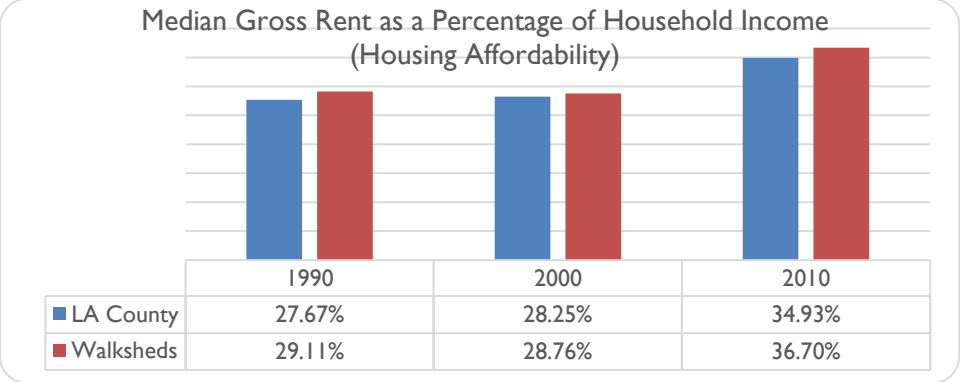

Figure 11. Graph Comparing Median Gross Rent as a Percentage of Household Income between LA County and Walksheds

The median gross rent as a percentage of household income reflects the burden of rent in households living in the region. According to the result of comparison analysis, the median gross rent as a percentage of household income had been constant in LA County and the Walksheds area between 1990 and 2000. However, in 2010, it rapidly increased in both regions. The area in the neighborhoods along the Metro Blue Line experienced a high percentage of median gross rent of household income. Housing affordability in the region became worse than previous years.

4.1.3. Summary

In 1990, the Walksheds areas along the Metro Blue line are regarded as marginalized and economically disadvantaged neighborhoods according to the comparison analysis. Compared to the average of Los Angeles County, the neighborhoods close to the station areas have more non-family households, fewer housing units, significantly lower median household income, a higher percentage of renter households, a remarkably low percentage of college graduates, lower in-migration, and a higher median gross rent as a percentage of household income. However, in 2000, the Walkshed area shows slightly better opportunity than 1990 as the gap between the Walksheds and the county was narrowing. In 2010, while the indicators of family structure, median gross rent as a percentage of household income, and in-migration became similar to the average of Los Angeles County, the rest of the indicators show that they still have a low affordability of housing and low investments to stabilize the neighborhoods. Interestingly, the Walksheds area remarkably outperforms the county in terms of the indicators of housing units and in-migration in 2010. However, the neighborhoods still have significantly low median household income and percentage of college graduates, as well as a very high percentage of renter households. To sum up, the Walksheds area experienced active demographic change due to in-migration. Moreover, there was a considerable new residential development due to high increase of housing units in Walksheds area. Considering the fact that the neighborhoods along the Blue line still show a low affordability of housing, there might be a risk of displacement in Walksheds during time periods studied.

4.2 2. COMPARISON ANALYSIS OF SOCIAL DEMOGRAPHIC INDICATORS AMONG TWENTY-TWO WALKSHEDS BY EACH DECADE

In this comparison analysis, I looked at the performance of each Walkshed area following a specific indicator. Each indicator of Walksheds is evaluated using ArcGIS. Based on the result of analysis, the top three Walksheds and lowest three Walksheds are chosen. In terms of time, 1990 is the starting point. The comparison analysis based on the data from 2000 and 2010 follows.

4.2.1. Family Structure (Family Household Ratio)

	Top 3		Lowest3	
Year	Walkshed	Ratio	Walkshed	Ratio
1990	Florence	0.88	Metro Center	0.32
	Artesia	0.85	1st Street	0.24
	Firestone	0.84	Long Beach Transit Mall	0.09
	Average Family Household Ratio		0.65	
2000	Florence	0.90	Pacific	0.54
	Slauson	0.88	1st Street	0.24
	Vernon	0.87	Metro Center	0.22
	Average Family Household Ratio		0.70	
2010	Florence	0.88	Long Beach Transit Mall	0.36
	Slauson	0.87	Metro Center	0.32
	Firestone	0.86	1st Street	0.28
	Average Family Household Ratio		0.67	

Table 9. Top 3 and Lowest 3 of Average Family Household Ratio of Walksheds

According to the results, Florence Walkshed has consistently been the highest share in family households. Most of the top 3 Walksheds in terms of family household ratio have a much higher share of the average family household ratio. However, the lowest 3 Walksheds have significantly lower family household ratio, which can be interpreted as the Walksheds that are made up of non-family households. In fact, 1st Street, Metro Center, and Long Beach Transit Mall Walksheds have been low ratio family households for decades. The Walksheds of the top 3 and lowest 3 did not change significantly according to the table. This fact might imply that the neighborhood change of family structure did not occur gradually after the operation of the Metro Blue Line. The map showing the average family household ratio was created.

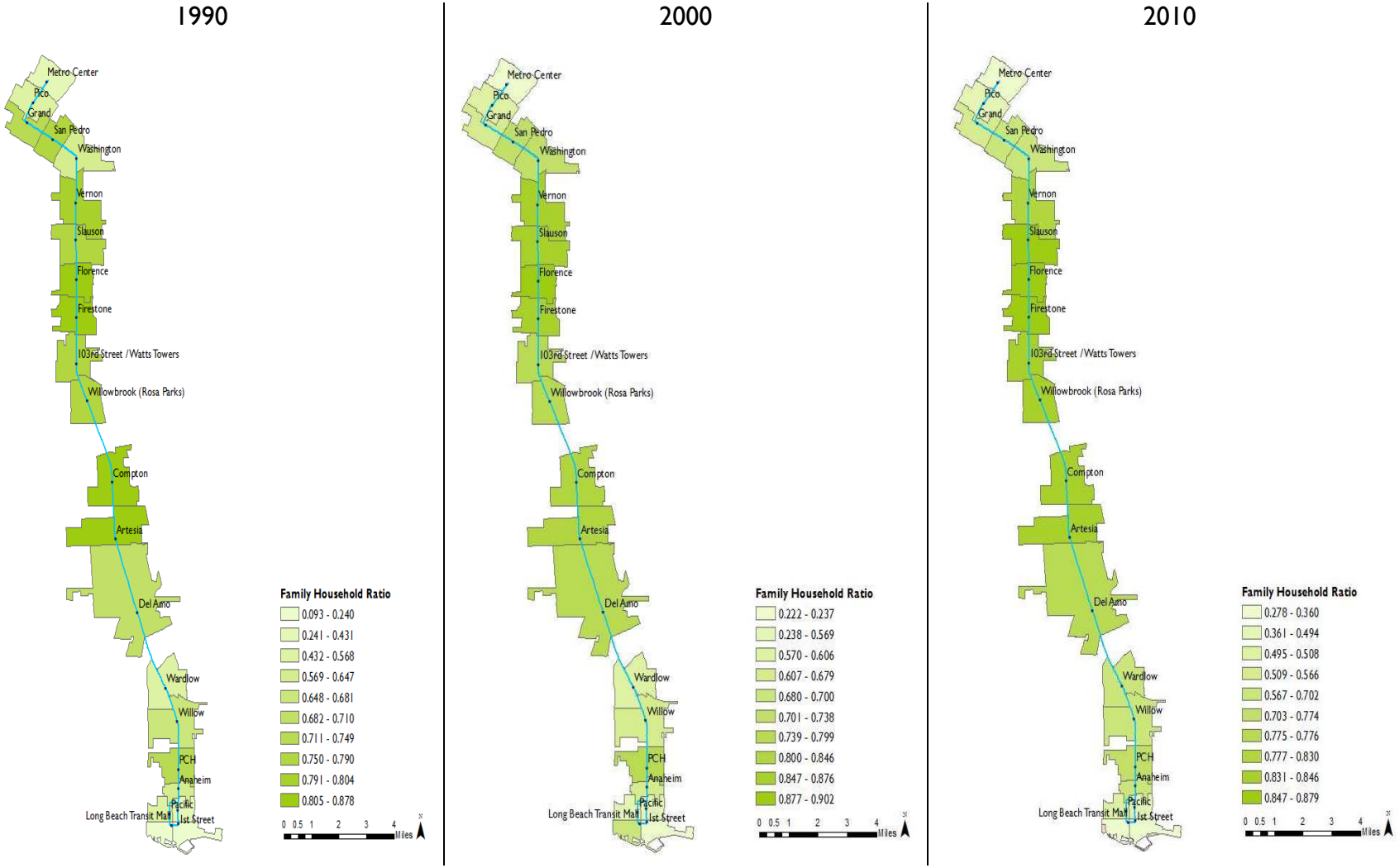

Figure 12. Maps Comparing Family Structure among Walksheds in 1990, 2000 and 2010

4.2.2. Housing Units

	Top 3		Lowest3	
Year	Walkshed	Units	Walkshed	Units
1990	Del Amo	796.75	Willowbrook (Rosa Parks)	240.31
	1st Street	711.57	Washington	211.22
	PCH	667.64	Long Beach Transit Mall	70.00
	Average housing units		390.26	
2000	1st Street	853.29	Grand	250.00
	Pacific	621.11	Washington	218.91
	Metro Center	600.11	Long Beach Transit Mall	66.33
	Average housing units		400.61	
2010	Metro Center	1246.62	103rd Street / Watts Towers	360.42
	1st Street	908.88	Compton	360.15
	Pico	904.68	Florence	345.00
	Average housing units		539.21	

Table 10. Top 3 and Lowest3 of Average Housing Units of Walksheds

Metro Center and 1st Street Walksheds have been in the Top 3 list for decades. Both Walksheds are located in Downtown Los Angeles, implying that Downtown Los Angeles region received more investment in new housing units due to its increased demands after the Blue line opened. However, the lowest 3 Walksheds by each decade have remarkably less housing units compared to average housing units per decade.

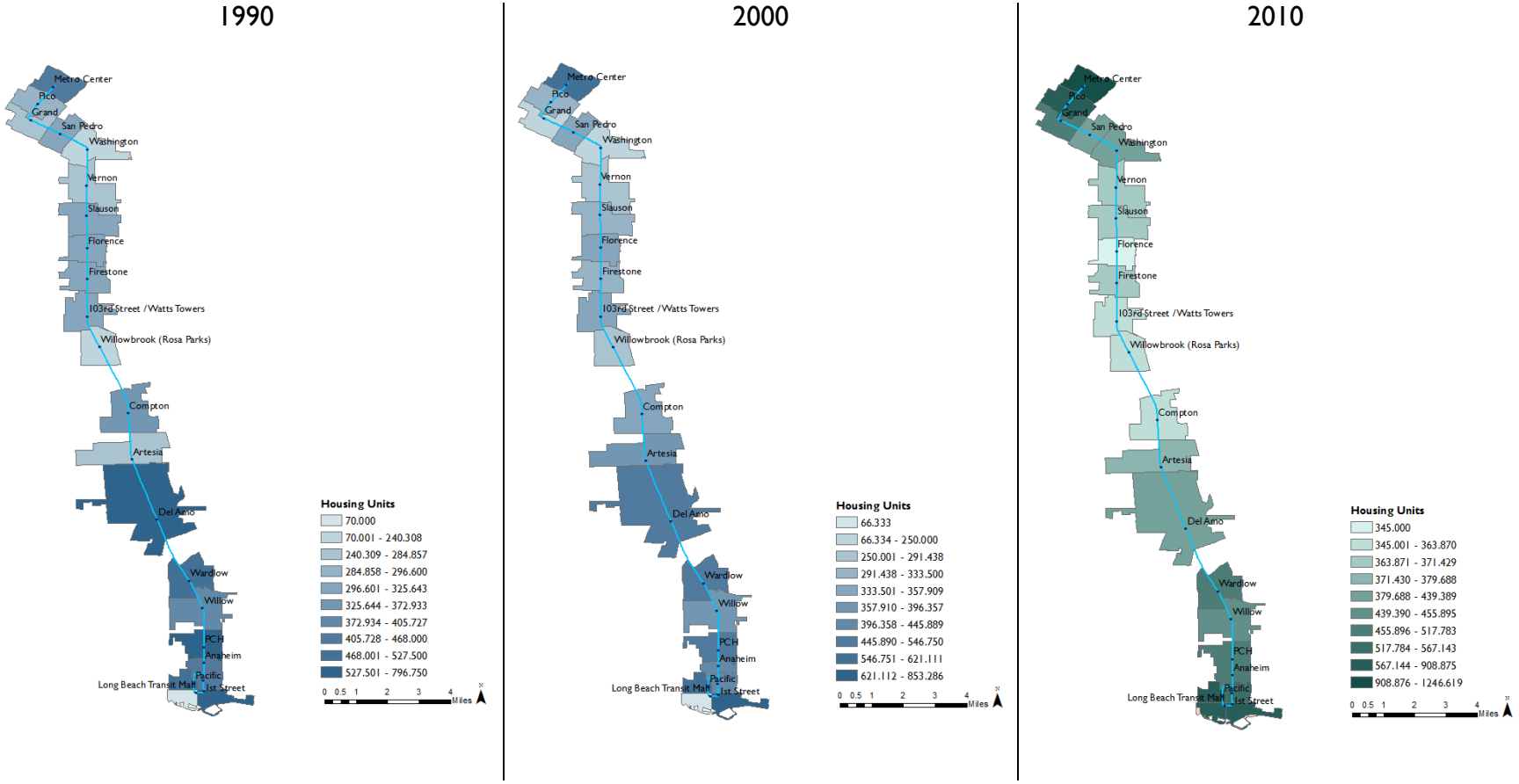

Figure 13. Maps Comparing Housing Units among Walksheds in 1990, 2000 and 2010

4.2.3. Median Household Income

	Top 3		Lowest3	
Year	Walkshed	Average Income	Walkshed	Average Income
1990	Wardlow	$ 44,332	Pico	$13,949
	Del Amo	$34,346	Metro Center	$10,251
	Willow	$34,057	Long Beach Transit Mall	$6,419
	Average Median Household Income		$20,389	
2000	Wardlow	$61,612	5th Street	$15,496
	Del Amo	$41,987	Long Beach Transit Mall	$9,583
	Willow	$39,762	Metro Center	$7,337
	Average Median Household Income		$27,036	
2010	Wardlow	$75,930	Pico	$24,710
	Del Amo	$56,831	Grand	$22,417
	Willow	$53,698	Metro Center	$21,501
	Average Median Household Income		$37,423	

Table 11. Top 3 and Lowest3 of Median Household Income of Walksheds

Interestingly, there has been no change in top three high median household income during 1990 – 2010. In particular, the Wardlow Walkshed has marked very high median household income and it has kept the top of the list. Moreover, Del Amo and Willow Walkshed have similar median household income over time. However, Long Beach Transit Center and several Walksheds in Downtown Los Angeles has been economically disadvantaged during time.

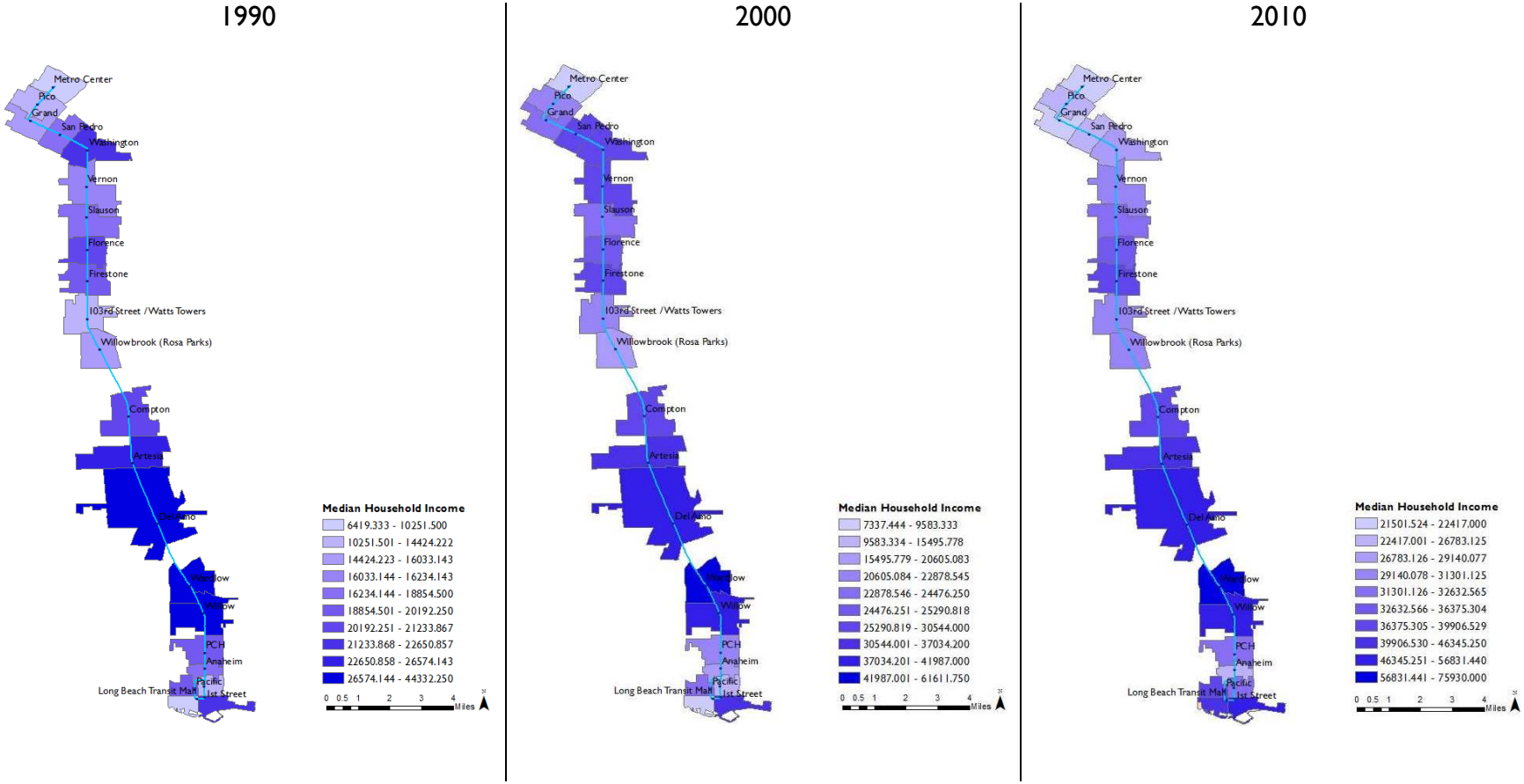

Figure 14. Maps Comparing Median Household Income among Walksheds in 1990, 2000 and 2010

4.2.4. Percent of Renter Households

	Top 3		Lowest3	
Year	Walkshed	Percentage	Walkshed	Percentage
1990	Grand	96.00%	Artesia	40.71%
	Anaheim	92.63%	Wardlow	36.00%
	5th Street	91.67%	Long Beach Transit Mall	29.00%
	Average Percent of Renter households		67.84%	
2000	5th Street	94.00%	Del Amo	40.50%
	Grand	92.88%	Artesia	38.40%
	Anaheim	90.90%	Wardlow	37.38%
	Average Percent of Renter households		68.56%	
2010	Pico	91.68%	Del Amo	36.08%
	Grand	90.75%	Artesia	36.06%
	Metro Center	88.43%	Wardlow	33.33%
	Average Percent of Renter households		68.71%	

Table 12. Top 3 and Lowest 3 of Average Percent of Renter Households of Walksheds

According to this result, Pico, Grand, and 5th Street Walksheds have a high share of renter households. In fact, this reflects the location of the station because Pico and Grand Walksheds are in Downtown Los Angeles, and the 5th Street Walkshed is located in Downtown Long Beach. Interestingly, it clearly shows that the most TOD (Transit Oriented Development) area in Downtown has a high share of renter households since the downtown area with transit usually tends to be developed with multifamily housing.for renters.

Figure 15. Maps Comparing Percent of Renter Households among Walksheds in 1990, 2000 and 2010

4.2.5. Percent of College Graduates

	Top 3		Lowest3	
Year	Walkshed	Percentage	Walkshed	Percentage
1990	Wardlow	40.63%	Slauson	4.50%
	1st Street	31.14%	Firestone	4.50%
	Willow	27.73%	Vernon	3.07%
	Average Percent of College Graduates		14.39%	
2000	1st Street	48.71%	Firestone	5.92%
	Wardlow	41.38%	Slauson	4.06%
	Pacific	24.78%	Florence	3.45%
	Average Percent of College Graduates		14.17%	
2010	1st Street	46.88%	Slauson	7.79%
	Wardlow	44.33%	Firestone	7.50%
	Long Beach Transit Mall	36.88%	Florence	7.09%
	Average Percent of College Graduates		19.60%	

Table 13. Top 3 and Lowest 3 of Average Percentage of College Graduates of Walksheds

The lowest 3 Walksheds have been on the list due to their low percentage of college graduates over the decades. They have a significantly lower share of residents who are college graduates in the neighborhoods. However, the top 3 Walksheds areas, 1st Street and Wardlow Walksheds, have a high share of educated people in the neighborhood. During 1990 to 2010, the change in the top three and lowest three Walksheds are not remarkable and it can be interpreted that there was no notable demographic shift in the Walksheds.

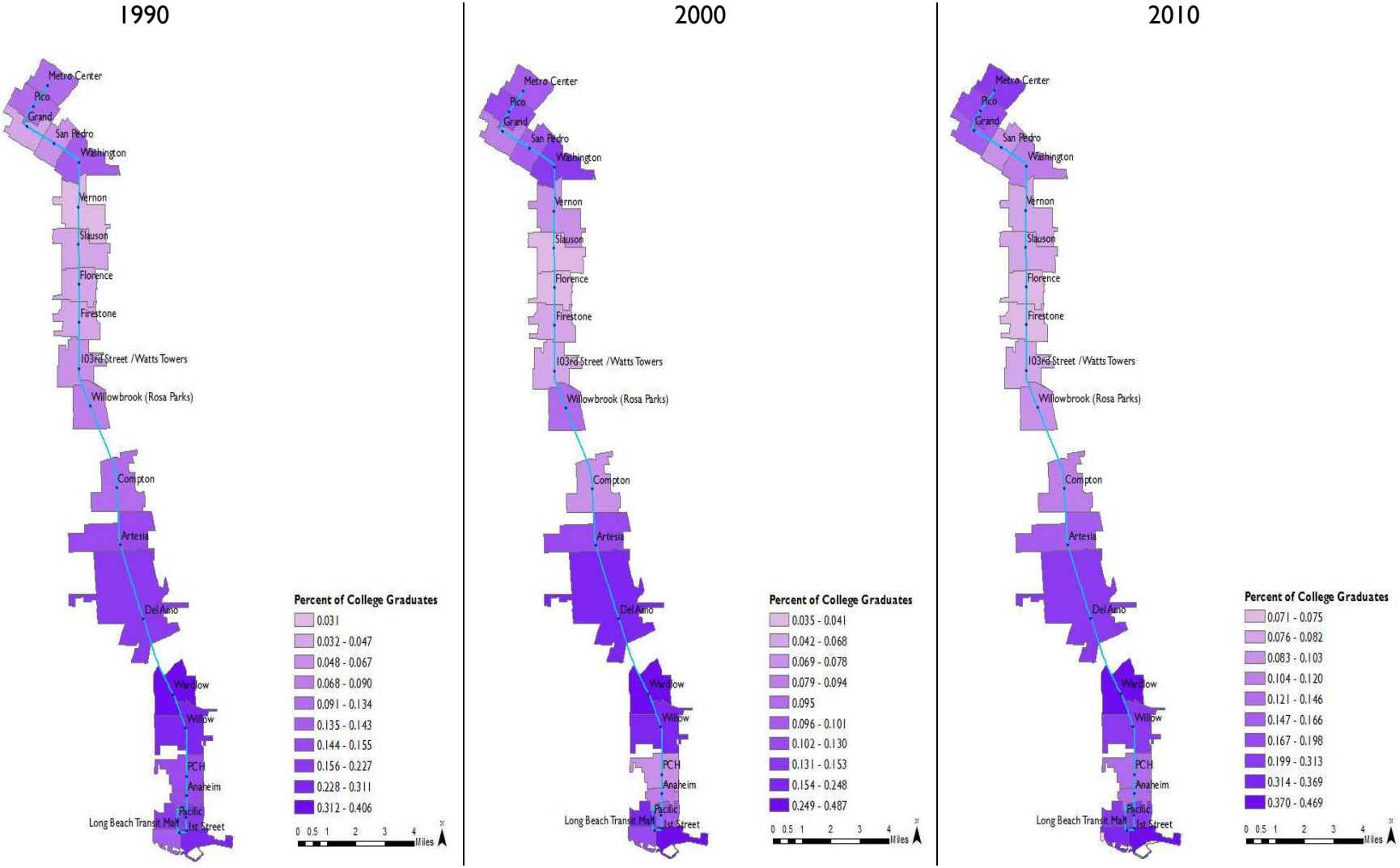

Figure 16. Maps Comparing Percent of College Graduates among Walksheds in 1990, 2000 and 2010

4.2.6. In-Migration

	Top 3		Lowest 3	
Year	Walkshed	Persons	Walkshed	Persons
1990	PCH	1338.18	Artesia	411.86
	Del Amo	1078.50	Willowbrook (Rosa Parks)	349.54
	Pacific	772.70	Long Beach Transit Mall	73.33
	Average In-Migration		595.04	
2000	PCH	1055.47	Washington	376.00
	Pacific	832.89	Grand	348.38
	1st Street	830.29	Long Beach Transit Mall	156.67
	Average In-Migration		583.72	
2010	PCH	414.96	San Pedro	140.89
	Metro Center	401.67	Florence	126.30
	1st Street	352.19	Del Amo	120.48
	Average In-Migration		235.38	

Table 14. Top 3 and Lowest 3 of Average In-Migration of Walksheds

PCH Walkshed significantly has had the highest number of in-migration over time. Following PCH, Pacific and 1st Street Walkshed areas also have a high influx of migration over the decades. Interestingly, while Del Amo Walkshed had high in-migration in 1990 as one of top three performing Walksheds, the influx of in-migration significantly decreased in 2010, making it one of the last three Walksheds. This result simply reflects the change in demographics over a period of time.

Figure 17. Maps Comparing In-Migration among Walksheds in 1990, 2000 and 2010

4.2.7. Median Gross Rent as a Percentage of Household Income

	Top 3		Lowest 3	
Year	Walkshed	Percentage	Walkshed	Percentage
1990	Firestone	34.39%	Grand	27.41%
	103rd Street / Watts Towers	33.87%	Metro Center	21.36%
	PCH	33.52%	Long Beach Transit Mall	8.70%
	Average Median Gross Rent as a Percentage of Household Income	29.11%		
2000	Artesia	37.59%	5th Street	24.06%
	103rd Street / Watts Towers	35.74%	Metro Center	19.94%
	PCH	34.97%	Long Beach Transit Mall	8.50%
	Average Median Gross Rent as a Percentage of Household Income	28.76%		
2010	Willowbrook (Rosa Parks)	44.58%	Del Amo	33.40%
	103rd Street / Watts Towers	43.19%	Long Beach Transit Mall	30.93%
	Anaheim	40.13%	1st Street	30.81%
	Average Median Gross Rent as a Percentage of Household Income	36.71%		

Table 15. Top 3 and Lowest 3 of Average Median Gross Rent as a Percentage of Household Income of Walksheds

103rd Street/Watts Towers Walkshed has been in the top three list of average median gross rent each decade. Moreover, PCH Walkshed also showed a high burden of housing cost due to its high percentage of average median gross rent as a percentage of household income. In contrast, Long Beach Transit Mall Walkshed maintained good performance of housing affordability since the Walkshed remained one of the lowest three Walksheds in each decade.

Figure 18 Maps Comparing Average Median Gross Rent as a Percentage of Household Income among Walksheds in 1990, 2000 and 2010

4.2.8. Summary

Through comparison analysis between twenty-two Walksheds, I was able to find clear patterns between Walksheds in city core and those in inner cities. Most of Walksheds in inner cities tend to have high family household ratio, high median household income, relatively low percent of renter households, high percentage of college graduates, and relatively high median gross rent as a percentage of household income. On the contrary, particular Walksheds in Downtown Los Angeles and Downtown Long Beach have shown massive influx of in-migration, significant investments for housing units, very low family household ratio, considerably low median household income, and very high percent of renter households. Some of these Walksheds also have high percent of college graduates. Interestingly, even though some Walksheds in downtown area have significantly low median income, they are shown relatively low burden of housing costs. This fact might come from the new construction of housing units over time.

4.3 COMPARISON ANALYSIS OF PERCENT CHANGE IN SOCIAL DEMOGRAPHIC INDICATORS BETWEEN LOS ANGELES COUNTY AND TWENTY-TWO WALKSHEDS BETWEEN DECADES (1990-2000, 2000-2010)

As with the first two compared analyses, this comparison analysis of percent change in social demographic indicators was investigated from two different viewpoints: first, time, and second, by each individual indicator. Since this analysis is based on the change in indicators over time, the data set was made as 1990-2000, and 2000-2010. Also, the results are presented by time period. By comparing the percentage change data on the basis of time, I was able to see the speed of change in social demographic indicators of the neighborhoods as well as the degree of change in neighborhoods along the Metro Blue Line. After looking at the percentage change in social demographic indicators by time period, each percentage change in indicators is presented by individual indicator in order to observe the trend of changes in the various indicators.

4.3.1. Snapshots by time periods

	Los Angeles County	Walksheds
Family Structure (Family Household Ratio)	2.00%	4.98%
Housing Units	-2.34%	4.67%
Median Household Income	27.28%	32.92%
Percent of Renter Households	-0.34%	0.72%
Percent of College Graduates	-17.61%	-0.22%
In-Migration	-8.01%	6.20%
Median Gross Rent as a Percentage of Household Income (Housing Affordability)	0.58%	-0.35%

Table 16. Percentage change in each indicator between Los Angeles County and Walksheds areas between 1990-2000

The neighborhood changes in Walksheds are notably different from the change in Los Angeles County, between 1990 and 2000, while Walksheds and the County have similar changes in terms of family structure. In terms of housing units, Walksheds received more investments for housing units since the changes in housing units in Walksheds are positive but the county's percent change in housing units are negative. Assuming that there were enough housing units existing in the Walksheds area, median gross rent as a percentage of household income became lower. It can be interpreted as housing affordability of Walksheds becoming better than before the Blue Line opened. Moreover, more people came into the Walksheds area while the average in-migration in the county are decreased. The share of the residents in Walksheds who are college graduates slightly decreased over time but compared to the county, the Walksheds experienced only small change in terms of change in college graduates. While the percent of renter housing households decreased in the county, the Walksheds experienced a small increase during the time period. Assuming that there was influx of in-migration during the time period, it can be interpreted as the increase in in-migration was greater than the speed of increase in housing units during the time period so that percent of renter households became slightly increased.

	Los Angeles County	Walksheds
Family Structure (Family Household Ratio)	-1.00%	-2.57%
Housing Units	4.11%	81.84%
Median Household Income	30.92%	55.69%
Percent of Renter Households	0.67%	0.15%
Percent of College Graduates	4.78%	5.43%
In-Migration	-235.16%	-52.24%
Median Gross Rent as a Percentage of Household Income (Housing Affordability)	6.68%	7.94%

Table 17. Percentage change in each indicator between Los Angeles County and Walksheds areas between 2000-2010

During the time period between 2000 and 2010, Los Angeles County and the Walksheds area experienced similar social demographic changes. In fact, looking at the percent change in housing units, the Walkshed area received more residential development compared to the county since the percent change in housing units is remarkably higher than the county. Assuming that fluent housing units might affect the change in percent of renter households since the increase of renter households are smaller than the county. Moreover, both of region, LA county and Walksheds experienced increase of college graduates and significant decrease of the influx of new residents. However, the decrease of in-migration in the county is remarkably rapid than the Walksheds area. In terms of increase of median household income, the walksheds experienced more rapid change in household income and it might give a sense of chance of displacement in the Walksheds area. While both of region marked increasing housing costs in terms of increase in median gross rent in household income, the burden of housing costs in Walksheds became larger than the county. It might be from that new construction or added housing units are expensive than previous housing units.

4.3.2. Overview by indicators

Percent Changes in Family Structure (Family Household Ratio)

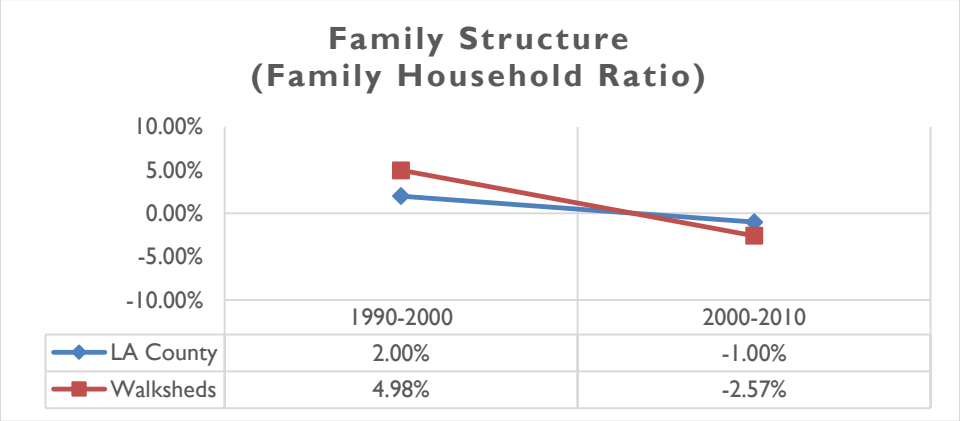

Figure 19. Graph comparing percent changes in family structure between LA County and Walksheds

While Los Angeles County and Walksheds have both experienced small changes in family household ratio during time periods studied, the households in Walksheds area became a higher percentage of non-family units. Moreover, the change in Walksheds is rapider than the change in LA County. It can be interpreted as the Walksheds are experienced more neighborhood change compared to that of the LA County. In fact, since there was a change of absolute terms of family households in Walksheds during time periods studied, it might mean there was displacement of local residents during decades.

Percent Changes in Housing Units

While LA County experienced decrease number of housing units and increase of housing units during the time periods, Walksheds have shown constantly increases in the number of housing units. Moreover, the degree of change of Walksheds is significantly

larger than that of LA County. This fact may reflect that in the beginning of the operation of the Metro Blue Line, the investment of the area was active. After 2000, the investment occurred significantly more than it had during 1990-2000. While considering there was even economic recession after 2008, new construction for residential development was actively occurred between 2000 and 2010 in Walksheds.

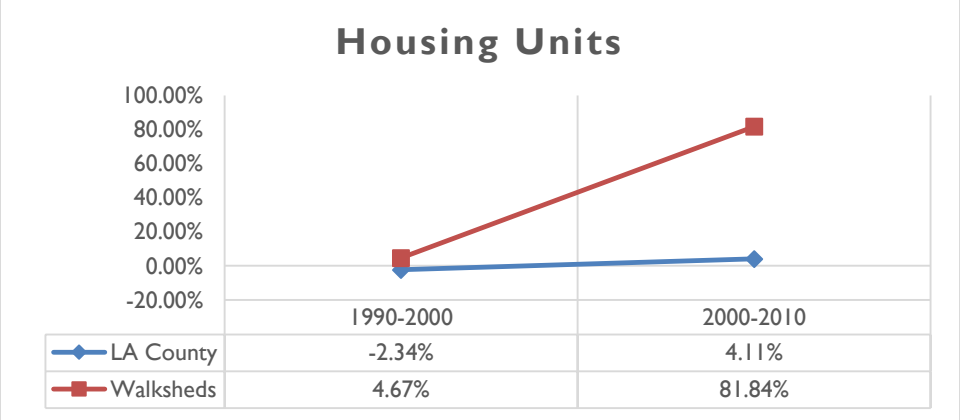

Figure 20. Graph comparing percent changes in housing units between LA County and Walksheds

Percent Changes in Median Household Income

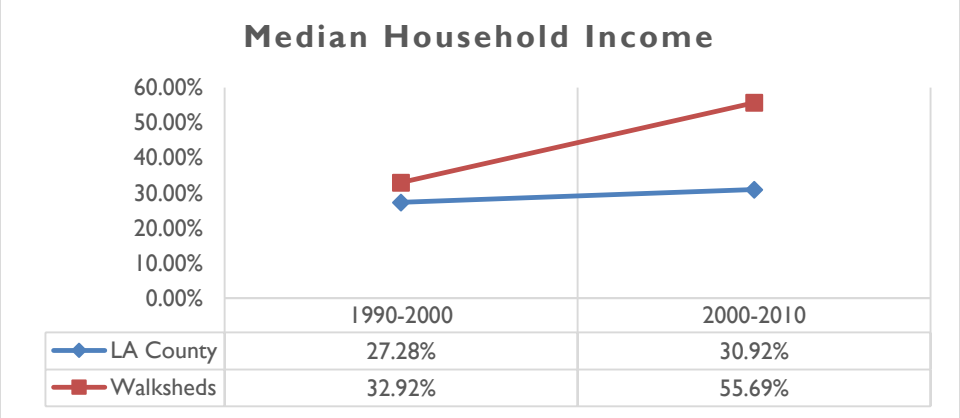

Figure 21. Graph comparing percent changes in median household income between LA County and Walksheds

Compared to the percent change in median household income of Los Angeles County, Walksheds experienced a very large increase in median household income, especially during 2000-2010. Moreover during the time period, 1990-2000 and 2000-2010, Walksheds are shown more and rapider change compared to the change of LA County. This can be interpreted as that the Walksheds along the rail line experienced gentrification during these time periods. Moreover, considering there was huge investment for new residential development around Walksheds according to the result of percent change in housing units between 2000 and 2010, this result might be a result of the fact that the original residents relocated to other region and the population in Walksheds replaced by higher income earners during the time period.

Percent Changes in Renter Households

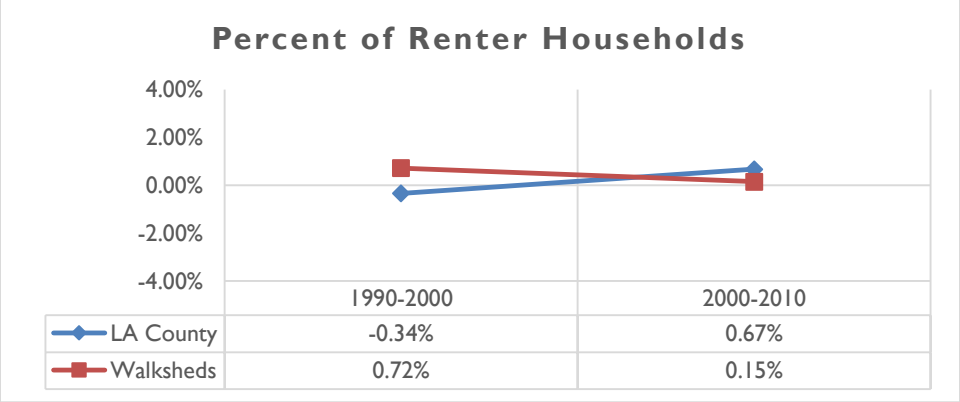

Figure 22. Graph comparing percent changes in renter households between LA County and Walksheds

While Los Angeles County and Walksheds both did not change a lot during the time periods, LA County become have more renter households in 2000-2010 compared to the 1990-2000 period. However, Walksheds area experienced slightly decrease in the share of renter households. It might be the consequence of the new construction of housing units occurred especially during the time period between 2000 and 2010.

Percent Changes in College Graduates

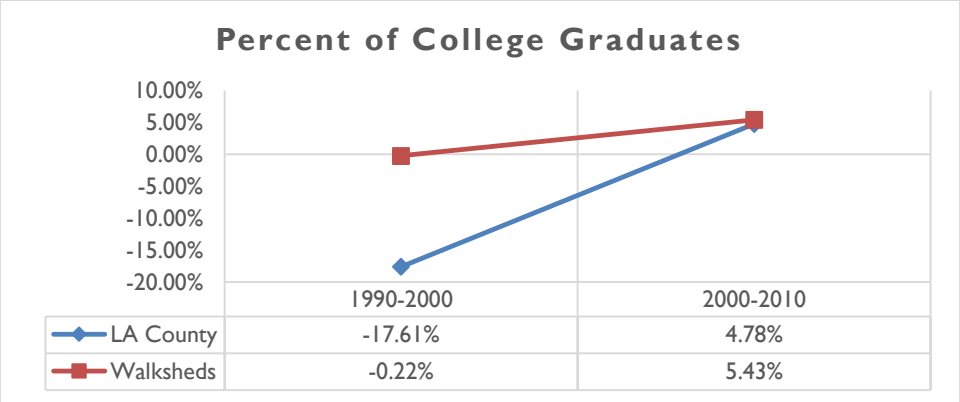

Figure 23. Graph comparing percent changes in college graduates between LA County and Walksheds

During 1990 to 2000, the share of residents who are college graduates in Walksheds and the Los Angeles County decreased in spite of large in-migration within that time period. The change in college graduates became positive for the next decade (2000-2010). Whole the degree of change in college graduate residents in Walksheds was less than the decrease of college graduate in the county during 1990 to 2000, the increase of college graduate residents in Walkseds was slightly higher than the county.

Percent Changes in In-Migration

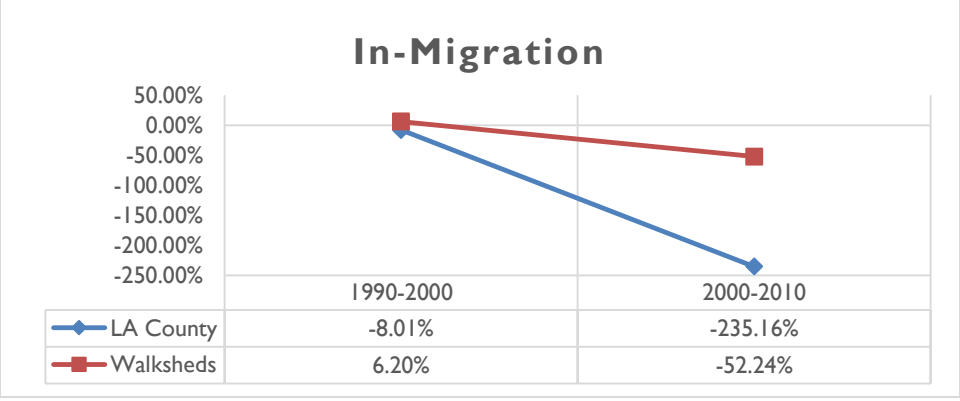

Figure 24. Graph comparing percent changes in in-migration between LA County and Walksheds

While Los Angeles County experienced decrease of influx of in-migration during 1990 to 2000, Walksheds experienced a notable influx of in-migration. However, during 2000-2010, the speed of in-migration became significantly negative compared to the previous time period. Los Angeles County experienced more drastic change in in-migration as compared to Walksheds. Positive percent change in in-migration in Walksheds during 1990 to 2000 may have been from the result of the introduction of rail line in the beginning of 1990. Moreover, slower decrease of in-migration than the county may have been from the result of the addition of new housing units in Walksheds.

Percent Changes in Median Gross Rent as a Percentage of Household Income (Housing Affordability)

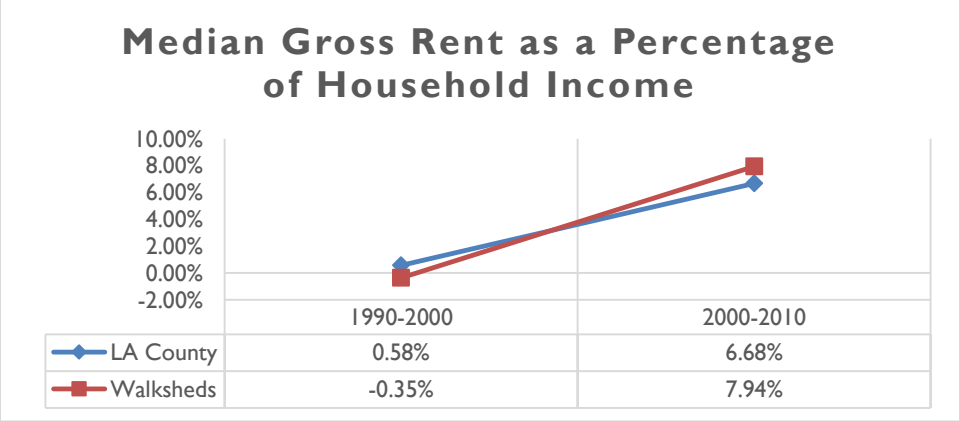

Figure 25. Graph comparing percent changes in percent changes in median gross rent as a percentage of household income between LA County and Walksheds

While change in median gross rent for Los Angeles County and Walksheds was very small during 1990 and 2000, the change rapidly increased during 2000 and 2010. Moreover, during the first time period, 1990-2000, the change in median gross rent in Walksheds was negative, which means that the housing cost in the neighborhoods became lighter. However, during 2000 to 2010, LA County and Walksheds both have an increase in median gross rent as a percentage of household income. It may be interpreted as the

burden of housing costs in the county and Walksheds became heavier. In fact, housing affordability became worse in Walksheds since new housing units are added but the burden of housing costs became heavier than the county.

4.3.3. Summary

The neighborhood changes in Walksheds are notably different from the change in Los Angeles County, between 1990 and 2000, while Walksheds and the County have similar changes in terms of family structure. However, in terms of the other indicators, the Walksheds have outperformed than the county since change in housing units was larger than the county and median gross rent as a percentage of household income became lower. Moreover, while in-migration in the county decreased, influx of in-migration in Walksheds increased.

During the time period between 2000 and 2010, Los Angeles County and the Walksheds area experienced similar social demographic changes. However, in terms of percent change in housing units, the Walkshed area received more residential development compared to the county since the percent change in housing units is remarkably higher than the county. Assuming that fluent housing units might affect the change in percent of renter households since the increase of renter households are smaller than the county. In terms of increase of median household income, the walksheds experienced more rapid change in household income and it might give a sense of chance of displacement in the Walksheds area. In addition, increase in median gross rent as a percentage of household income in Walksheds also indicates that the Walksheds neighborhoods might become more vulnerable to displacement.

4.4. COMPARISON ANALYSIS OF PERCENT CHANGE IN SOCIAL DEMOGRAPHIC INDICATORS AMONG TWENTY-TWO WALKSHEDS BETWEEN DECADES (1990-2000, 2000-2010)

In this comparison analysis among twenty-two Walksheds, I examined how rapidly the neighborhoods in the proximity to the station have changed while some neighborhoods did not. As in the previous analysis, percentage change in indicators of Walksheds was evaluated using ArcGIS. Based on the result of analysis, the top three of the Walksheds areas regarding each positive and negative change were chosen by investigation. Tables and maps were created based on each estimate of indicator and time. Through this analysis, I expected to see the impact of the Metro Blue Line regarding whether its influence was positive or negative to the close neighborhoods.

4.4.1 Percent Change in Family Structure (Family Household Ratio)

	Positive Change (+)		Negative Change (-)	
Year	Walkshed	Percentage	Walkshed	Percentage
1990 - 2000	Long Beach Transit Mall	60.67%	San Pedro	-5.25%
	5th Street	13.78%	Grand	-7.18%
	Slauson	9.22%	Metro Center	-10.18%
	Average Percent Change in Family Household Ratio		4.98%	
2000 - 2010	Metro Center	9.35%	Grand	-9.62%
	Wardlow	4.84%	Pico	-10.73%
	Willowbrook (Rosa Parks)	4.54%	Long Beach Transit Mall	-34.00%
	Average Percent Change in Family Household		-2.57%	

Table 18. Most Changed Walksheds in Percent Change in Family Household Ratio of Walksheds

In terms of percentage change in family household ratio, positive change implies that more households in Walksheds were family households and negative change in this indicator means more households were non-family. Looking at the degree of change in family household ratio during 1990 to 2000, Walksheds that have changed positively have changed more rapidly as compared to the Walksheds that have changed negatively. On the contrary, during 2000 to 2010, Walksheds that have changed negatively have changed more rapidly as compared to the Walksheds that have changed positively. Interestingly, Long Beach Transit Mall Walkshed area marked a high percentage of change in family household ratio during these two different time periods. Long Beach Transit Mall Walkshed is shown as the significantly positive change in 1990-2000 and the next decade negatively changed. On the contrary, Metro Center Walksheds experienced opposite neighborhood change during the time periods compared to the Long Beach Transit Mall Walkshed. Both Walksheds are located in the Downtown Long Beach and Downtown Los Angeles respectively. Therefore, this fact might be connected to the fact that Walksheds in the downtown areas are more vulnerable to displacement or drastic demographic shifts.

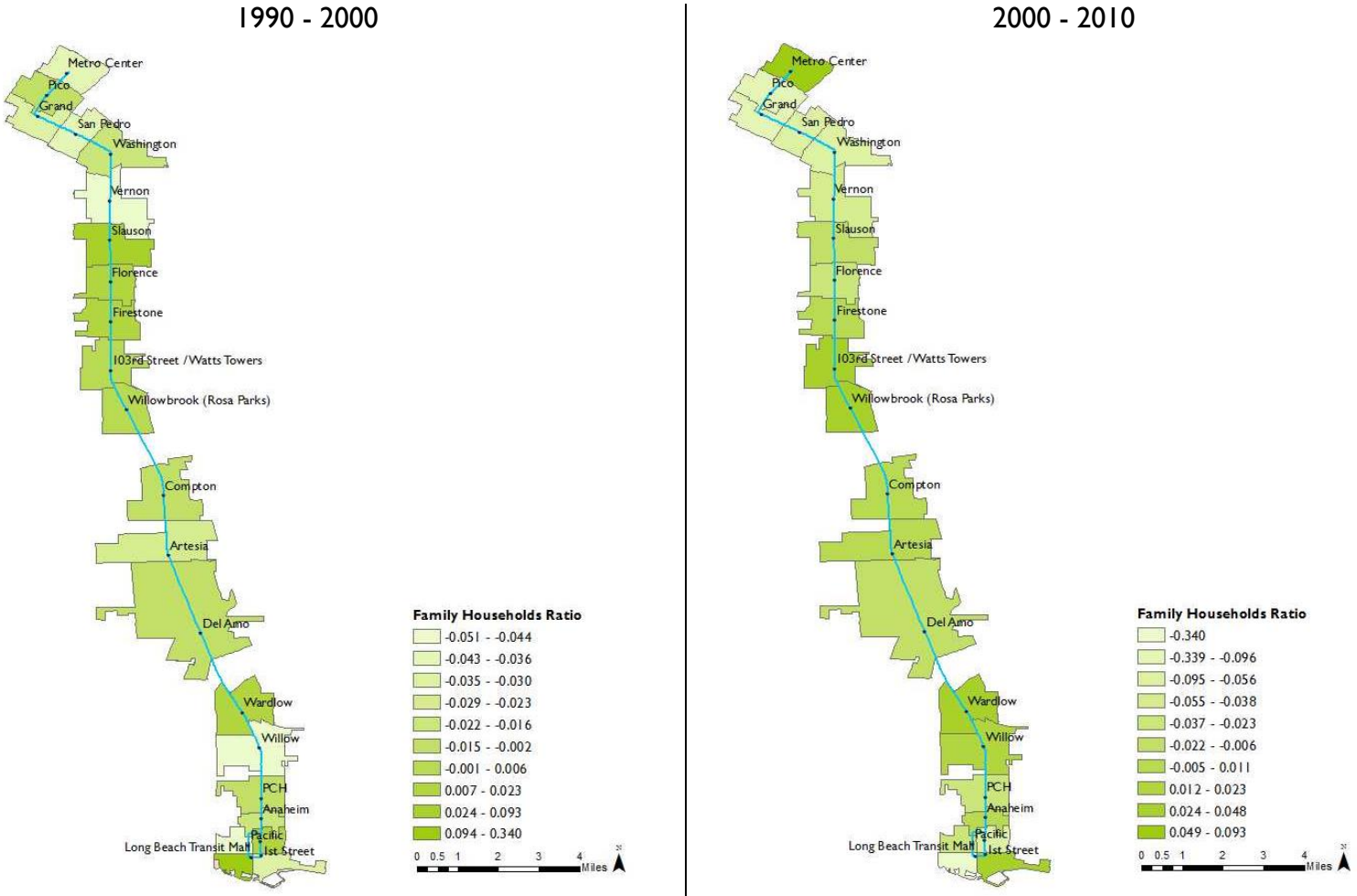

Figure 26. Maps Comparing Percent Change in Family Structure among Walksheds in 1990-2000, and 2000-2010

4.4.2. Housing Units

	Positive Change (+)		Negative Change (-)	
Year	Walkshed	Percentage	Walkshed	Percentage
1990 - 2000	Artesia	41.00%	Grand	-12.24%
	Metro Center	35.47%	PCH	-23.40%
	Pacific	20.44%	Del Amo	-32.54%
	Average Percent Change in Housing Units		4.67%	
2000 - 2010	Long Beach Transit Mall	1148.62%	Artesia	-3.97%
	Pico	188.12%	Wardlow	-10.32%
	Metro Center	107.73%	Del Amo	-21.14%
	Average Percent Change in Housing Units		81.84%	

Table 19. Most Changed Walksheds in Percent Change in Housing Units of Walksheds

According to the above table, there is a significant gap between positively changed neighborhoods and negatively changed neighborhoods. This finding may imply that uneven investment has occurred among the Walksheds along the rail line. The gap among uneven investment of housing might have brought inequitable opportunities for neighborhoods and it might have caused unbalanced development of neighborhoods. Moreover, while looking at the degree of the change in housing units, the time period between 2000 and 2010 was greater than the time period during 1990 to 2000. In addition, Walksheds in downtown areas are shown more positive change than Walksheds in inner cities. This fact might be connected to the fact that Walksheds in the downtown areas were more attractive for new residential development. However, it can be interpreted as that they have more increased risk of displacement.

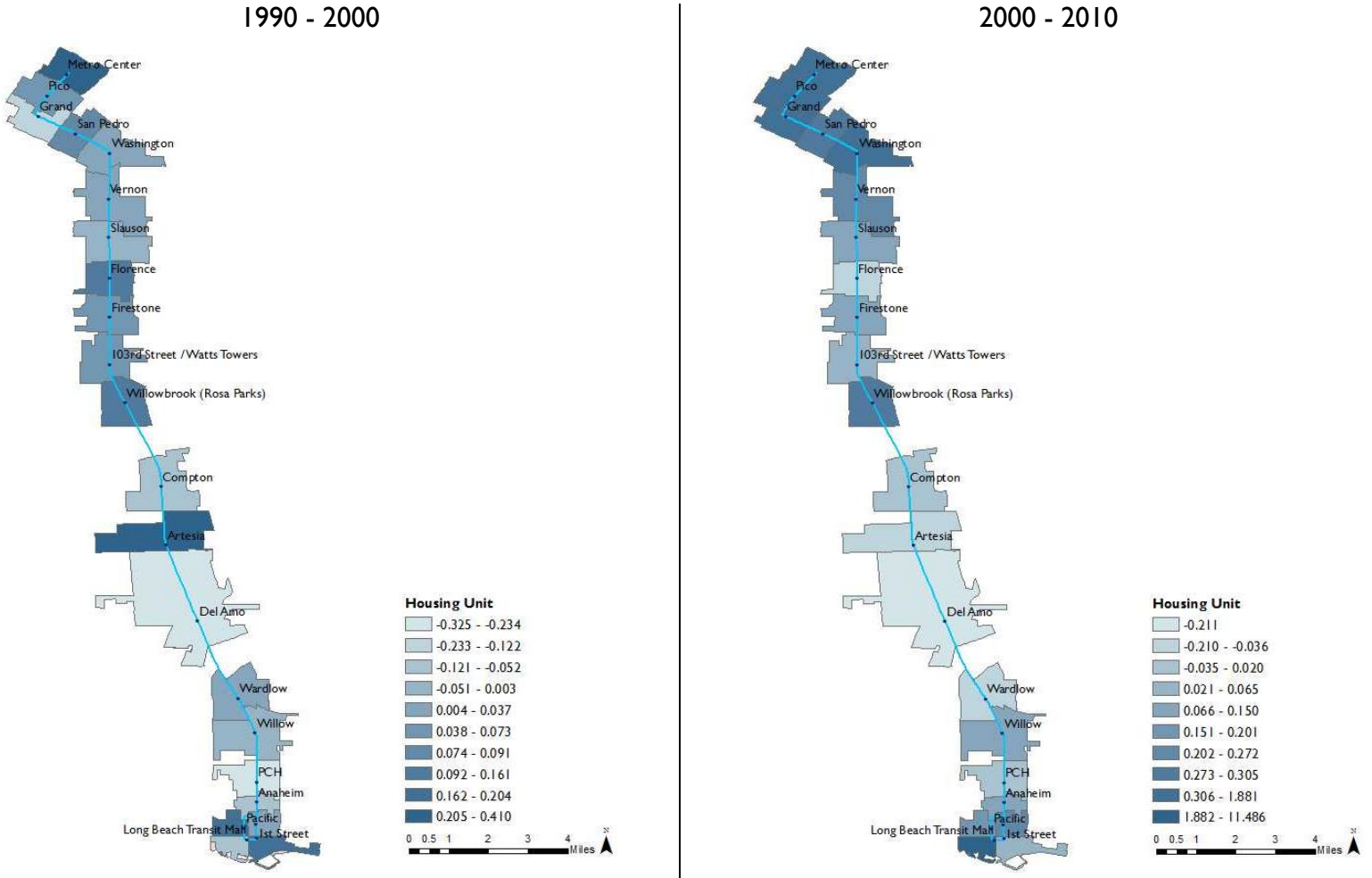

Figure 27. Maps Comparing Percent Change in Housing Units among Walksheds in 1990-2000, and 2000-2010

4.4.3. Median Household Income

	Positive Change (+)		Negative Change (-)	
Year	Walkshed	Percentage	Walkshed	Percentage
1990 - 2000	Vernon	77.99%	Metro Center	-28.43%
	Pico	64.01%		
	103rd Street / Watts Towers	58.64%		
	Average Percent Change in Median Household Income		32.92%	
2000 - 2010	Long Beach Transit Mall	355.00%	Washington	-4.60%
	Metro Center	193.04%	San Pedro	-4.92%
	5th Street	109.03%	Grand	-8.41%
	Average Percent Change in Median Household Income		55.69%	

Table 20. Most Changed Walksheds in Percent Change in Median Household Income of Walksheds

During 1990 to 2000, only Metro Center Walkshed have negative change in terms of median household income, while Pico Walkshed, which is right next to Metro Center Walkshed, marked high increase in median household income. On the contrary, during 2000 to 2010, Metro Center Walkshed experienced high increase in median household income. Moreover, Long Beach Transit Mall and 5th Street Walksheds have significantly high increase in median household income between 2000 and 2010. This fact might imply that those neighborhoods that experienced increasing median household income had more influx of high income people. It can also imply that those neighborhoods experienced gentrification and displacement of the low income residents. Interestingly, those neighborhoods are located in the core of the city and this reveals that neighborhoods in core city area may be more vulnerable to the gentrification or displacement.

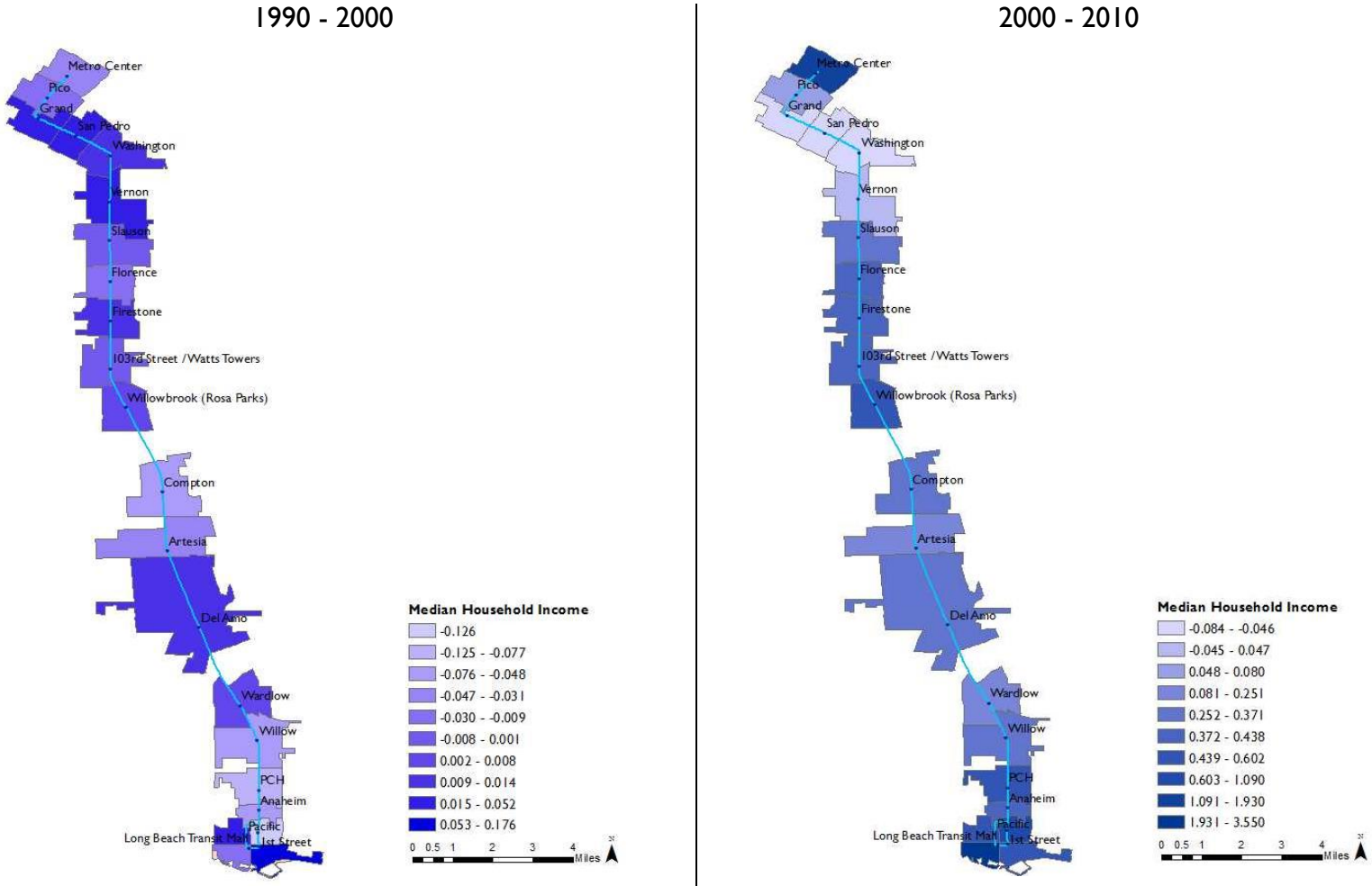

Figure 28. Maps Comparing Percent Change in Median Household Income among Walksheds in 1990-2000, and 2000-2010

4.4.4. Percent Change in Renter Households

	Positive Change (+)		Negative Change (-)	
Year	Walkshed	Percentage	Walkshed	Percentage
1990 - 2000	Long Beach Transit Mall	34.00%	Vernon	-4.38%
	Slauson	9.28%	Pacific	-4.58%
	5th Street	2.33%	Willow	-5.10%
	Average Percent Change in Renter Households		0.72%	
2000 - 2010	Pico	9.59%	Anaheim	-4.84%
	1st Street	8.01%	5th Street	-7.79%
	Willowbrook (Rosa Parks)	5.99%	Compton	-8.39%
	Average Percent Change in Renter Households		0.15%	

Table 21. Most Changed Walksheds in Percent Change in Renter Households of Walksheds

According to the results, the change in renter households between 1990 and 2000 is higher than the change between 2000 and 2010. Moreover, during the time period of 1990 to 2000, the share of residents that are renters in Long Beach Transit Mall Walksheds enormously increased. When looking at 5th Street Walkshed, during 1990 and 2000, the the share of renter households became larger, but, in the next decade, the percent change in renter households became negative. This means that the 5th Street Walkshed neighborhood became less vulnerable to displacement and more affordable to live in since the change in renters is a negative one. Moreover, most neighborhoods that experienced increased renter households in their population are located in downtown Los Angeles or downtown Long Beach. This might be connected to the fact that the downtown area is more unstable than the areas not located in the city core.

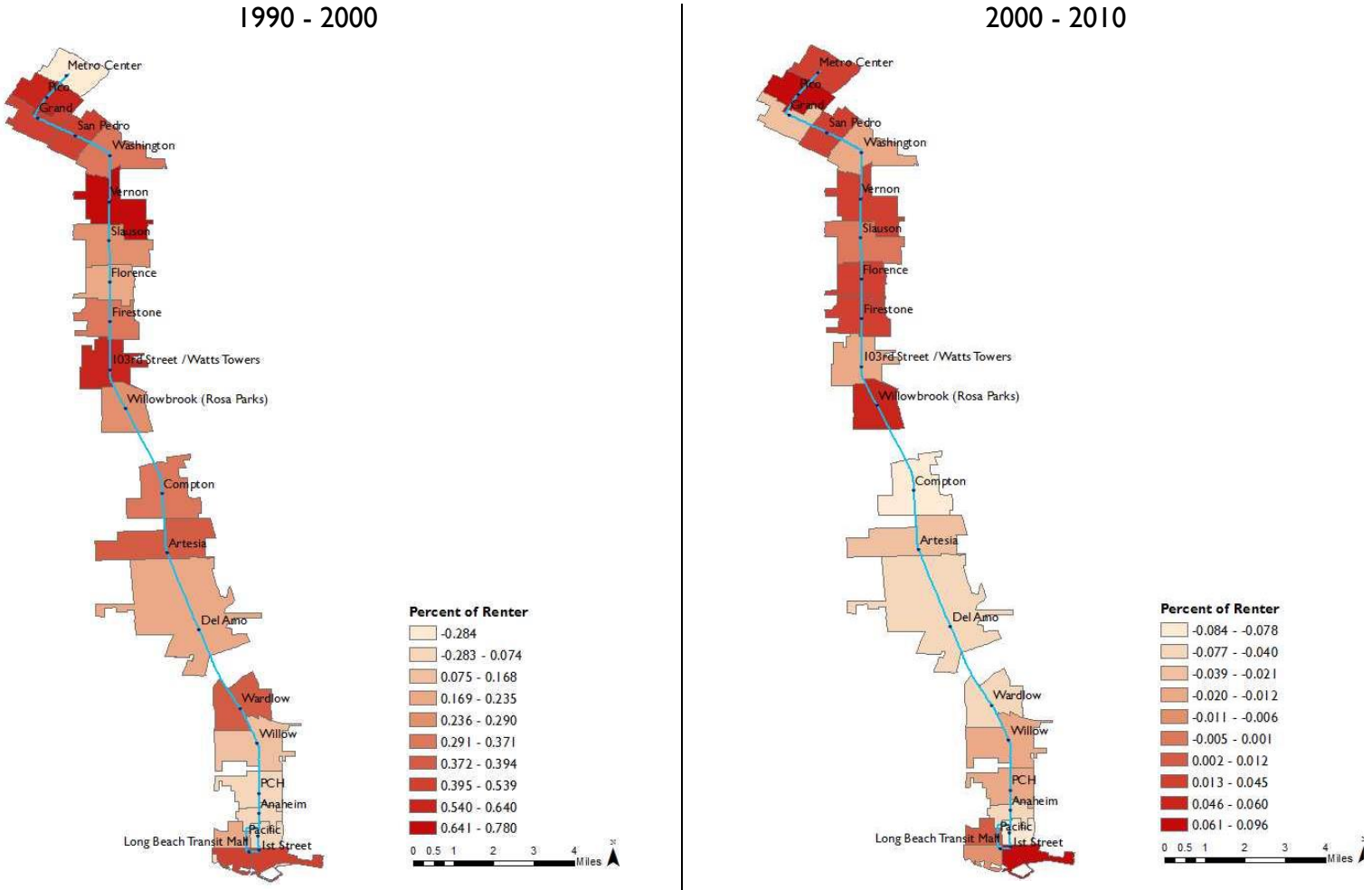

Figure 29. Maps Comparing Percent Change in Renter Households among Walksheds in 1990-2000, and 2000-2010

4.4.5. Percent Change in College Graduates

	Positive Change (+)		Negative Change (-)	
Year	Walkshed	Percentage	Walkshed	Percentage
1990 - 2000	1st Street	17.57%	Anaheim	-5.48%
	Long Beach Transit Mall	5.18%	PCH	-7.75%
	Grand	4.80%	5th Street	-12.56%
	Average Percent Change in College Graduates		-0.22%	
2000 - 2010	Long Beach Transit Mall	23.88%	Willowbrook (Rosa Parks)	-0.41%
	Metro Center	21.17%	1st Street	-1.84%
	5th Street	15.46%	Washington	-3.27%
	Average Percent Change in College Graduates		5.43%	

Table 22. Most Changed Walksheds in Percent Change in College Graduate of Walksheds

As shown in the above table, the neighborhoods that experienced high increase in the number of college graduates over time are: Metro Center, 1st Street and Long Beach Transit Mall Walksheds. While these specific areas experienced a higher percentage than average change in college graduates as a total area Walksheds had a decrease college graduates are changed over time. While the average percent change in college graduates in 1990-2000 is very small and even a negative, the change in 2000-2010 is bigger and positive change which means total Walksheds received more influx of college graduates. Moreover, while Walksheds in inner cities marked negative change in college graduates, Walksheds in the city core have more college graduates over time. Therefore, it can be interpreted as that the unbalanced influx of in-migration or investments among Walksheds became serious over time.

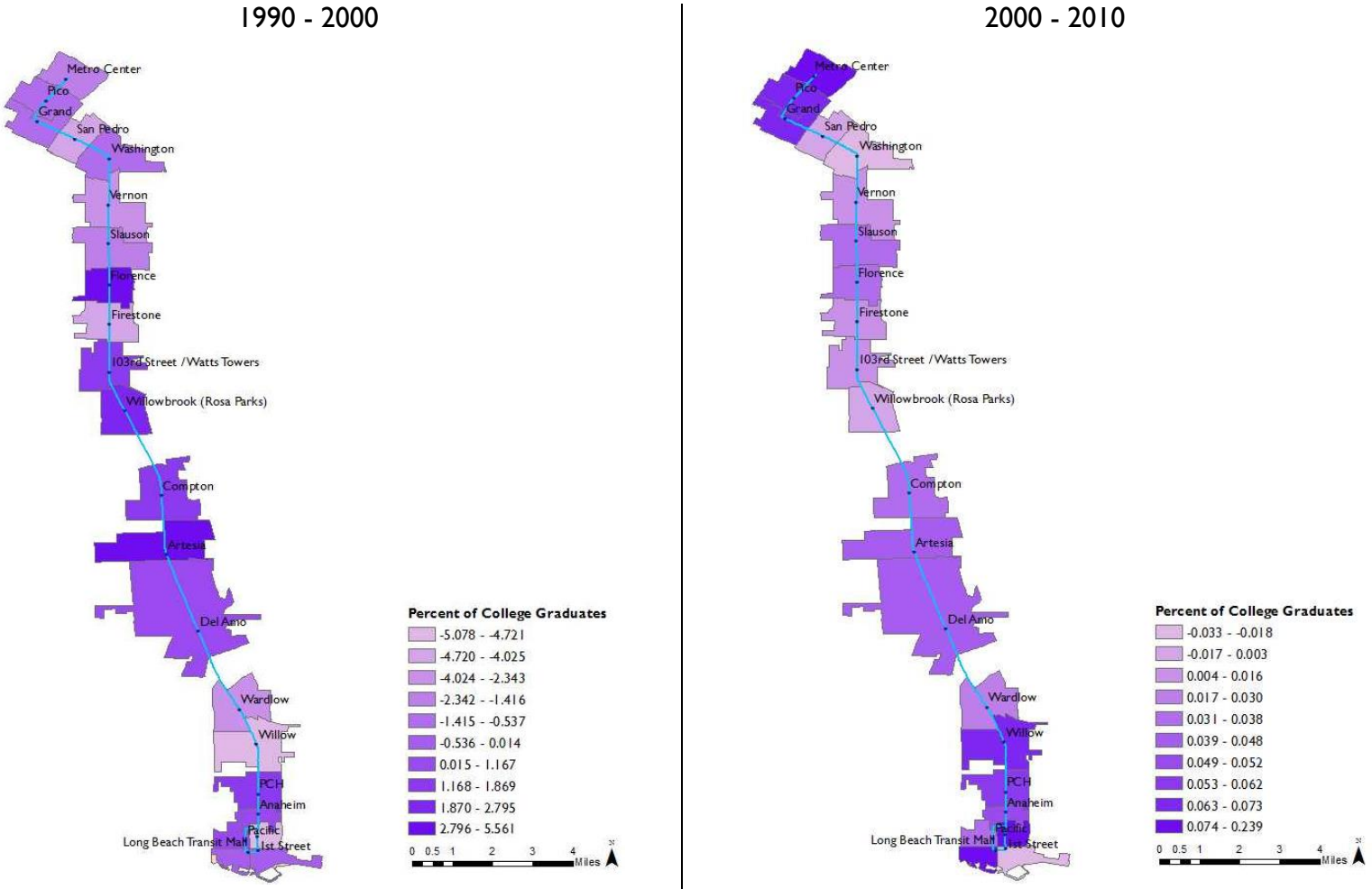

Figure 30. Maps Comparing Percent Change in College Graduates among Walksheds in 1990-2000, and 2000-2010

4.4.6. Percent Change in In-Migration

	Positive Change (+)		Negative Change (-)	
Year	Walkshed	Percentage	Walkshed	Percentage
1990 - 2000	Long Beach Transit Mall	113.64%	Compton	-24.80%
	1st Street	30.55%	Del Amo	-36.59%
	Artesia	28.76%	Grand	-40.11%
	Average Percent Change in In-Migration		6.20%	
2000 - 2010	Long Beach Transit Mall	120.53%	San Pedro	-78.03%
			Florence	-78.61%
			Del Amo	-82.38%
	Average Percent Change in In-Migration		-52.24%	

Table 23. Most Changed Walksheds in Percent Change in In-Migration of Walksheds

During 1990-2000, while the average percent change in in-migration was positive, Compton, Del Amo and Grand Walksheds experienced decreases in-migration. On the contrary, Long Beach Transit Mall Walkshed had a considerable influx of people in the region during the same time period.

During 2000-2010, while the average percent change in in-migration was significantly negative, only Long Beach Transit Mall Walksheds had a positive percent of change in in-migration. Interestingly, only Long Beach Transit Mall Walkshed experienced increasing in-migration during two different decades studied. In fact, the in-migration of Long Beach Transit Mall Walkshed became greater than the previous time period.

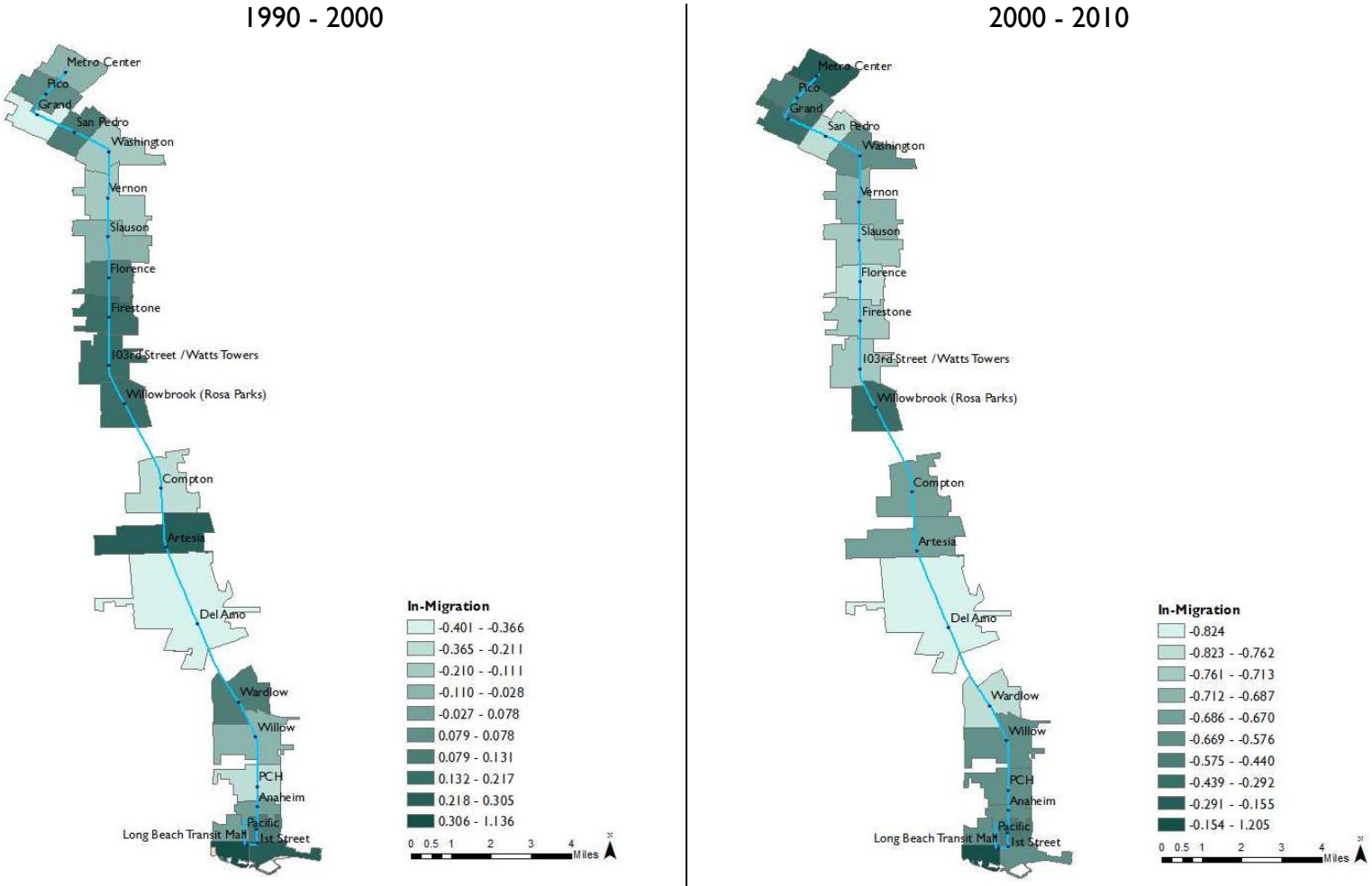

Figure 31. Maps Comparing Percent Change in In-Migration among Walksheds in 1990-2000, and 2000-2010

4.4.7. Percent Change in Median Gross Rent as a Percentage of Household Income

	Positive Change (+)		Negative Change (-)	
Year	Walkshed	Percentage	Walkshed	Percentage
1990 - 2000	Artesia	5.56	Firestone	-4.08
	Florence	4.51	Willow	-4.72
	Willowbrook (Rosa Parks)	2.80	5th Street	-5.08
	Average Percent Change in Median Gross Rent		-0.35%	
2000 - 2010	Long Beach Transit Mall	22.43	Artesia	-4.10
	Metro Center	14.63		
	5th Street	14.54		
	Average Percent Change in Median Gross Rent		7.94%	

Table 24. Most Changed Walksheds in Percent Change in Median Gross Rent of Walksheds

Positive change in median gross rent as a percentage of households' income implies that the neighborhoods have a bigger burden of housing costs so the housing affordability can worsen in the area. However, negative change means better housing affordability since the housing cost does not take a big proportion of household income. During 1990 and 2000, Artesia, Florence and Willowbrook (Rosa Parks) Walksheds experienced considerable change due to its high percentage of change in median gross rent while the average percent change was negative. In the same time period, 5th Street Walkshed had a substantial decrease the burden of housing cost. During 2000 and 2010, Long Beach Transit Mall Walkshed had rapidly changing unaffordability due to its high percentage change in median gross rent. However, Artesia Walkshed became more affordable due to its negative change in median gross rent and it was only Walkshed that had a negative change in median gross rent percentage among twenty-two Walksheds.

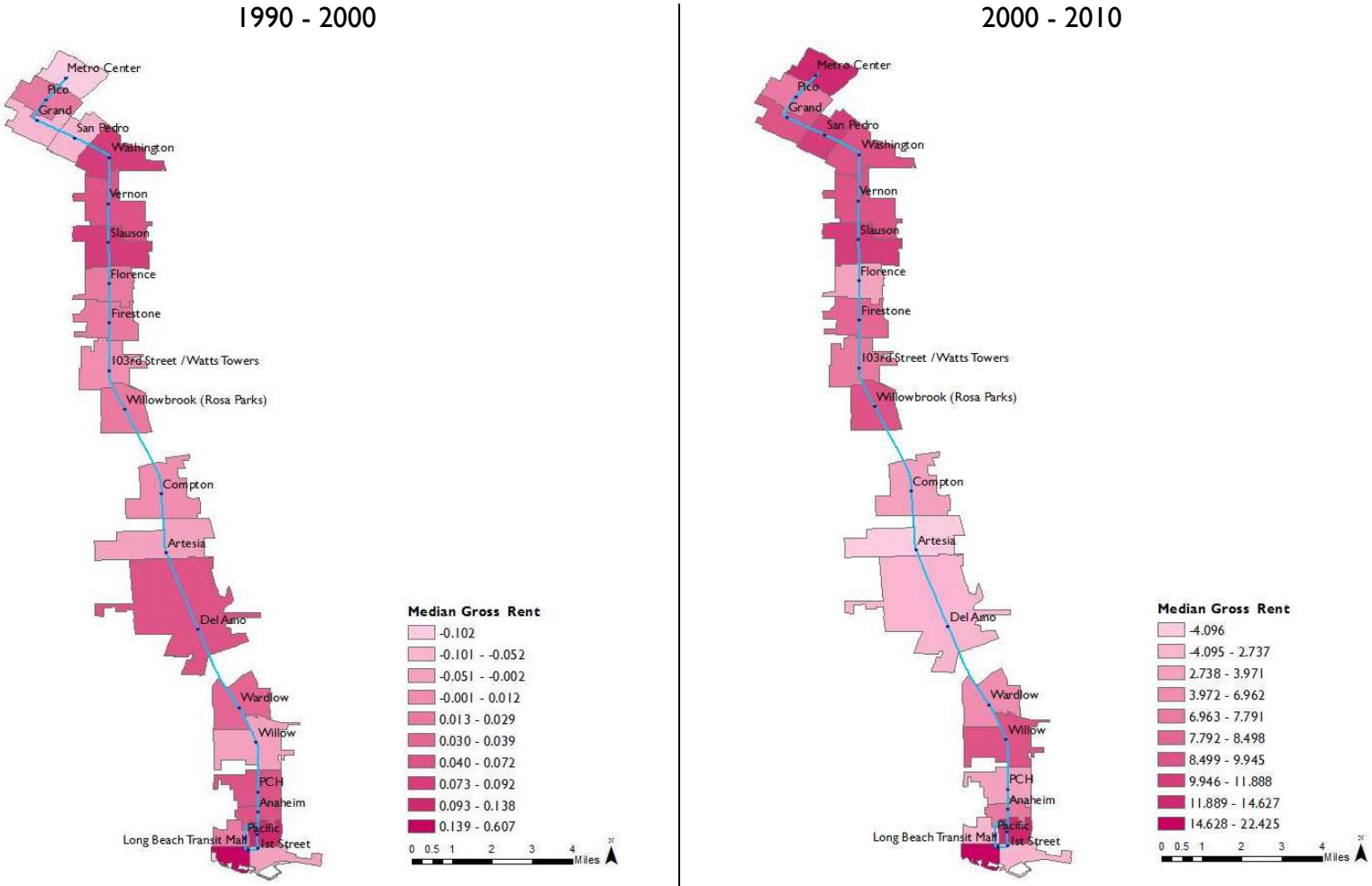

Figure 32. Maps Comparing Percent Change in Median Gross Rent among Walksheds in 1990-2000, and 2000-2010

4.4.8. Summary

Considering the result from the comparison analysis of percent change in indicators among twenty-two Walksheds, some clear patterns are emerging. Most changed Walksheds during different two time periods are mostly located in the city core whether the neighborhood change occurred positively or not. In particular, Metro Center Walkshed in Downtown Los Angeles and Long Beach Transit Mall in Downtown Long Beach have shown drastic neighborhood change during the time period. Through looking at great change in median household income, housing units, and median gross rent as a percentage of household income in Metro Center Walkshed and Long Beach Transit Mall Walkshed, they have experienced upward mobility but at the same time it may be a sign of displacement. In conclusion, some Walksheds became more vulnerable to displacement and only few Walksheds already have experienced displacement, while most of Walksheds are disinvested.

Chapter 5: Conclusion

This report set out to evaluate and compare specific neighborhood changes along the Metro Blue Line in Los Angeles County in the viewpoint of their social equity impact. In order to better understand patterns of neighborhood change in proximity to the transit stations, comparison analysis was conducted based on socioeconomic and demographic changes in twenty-two areas designated Walksheds by the Metro Blue Line. The comparison analysis between Los Angeles County and neighborhoods in proximity to the Metro Blue Line stations used a series of social demographic indicators. Setting the start point at 1990, comparison analysis was employed to observe the pattern of change in the region by decennial data, followed by 2000 and 2010. While looking at change through time series data analysis vertically, the performance of each station area was examined horizontally. Through a comparison of station performance on the basis of decennial data, the result revealed which neighborhoods were positively changed and which were negatively impacted from the rail line.

Seven social demographic indicators were chosen and utilized for the four stages of comparison analysis in this report. The first and second results came from a comparative analysis that is based on the average estimates of household type, total housing units, in-migration, education attainment of the population (25 years and older), median household income, median gross rent as a percentage of household income, and tenure status. Through the change in household type and education attainment of the population (25 years and older), I expected to see how the population composition of neighborhood changed over time. The indicator of total housing units was utilized to determine whether investment occurred in the neighborhoods during the time period in order for upward mobility. The indicator of median household income is considered to determine whether the region gentrified. Combined together with median household income, median gross rent as a percentage of household income, and tenure status, I was able to figure out how the housing

affordability changed over time in the selected neighborhoods. In brief, these indicators provide a sense of the characteristics of each neighborhood and how the neighborhoods are different from Los Angeles County. Moreover, looking at the social demographic indicators over time can tell us whether there is a displacement or gentrification in the selected neighborhoods. After comparing average estimates of indicators for each decade and region, comparing Los Angeles County versus twenty-two Walksheds areas, the comparison analysis was conducted based on the social demographic changes, in percentage, in both Los Angeles County and the Walksheds between decades (1990 – 2000 and 2000 – 2010). Evaluating neighborhood change can be useful to determine where investments are necessary or which neighborhoods have already experienced displacement, gentrification, or unwanted demographic shifts.

According to the results, the twenty-two Walksheds along the Metro Blue Line still remain places that are undesirable to live in, and are both marginalized and economically disadvantaged. While looking at the result of comparison analysis of social demographic indicators between Los Angeles County and twenty-two Walksheds from 1990 to 2010, the neighborhoods in the vicinity of the rail line have had a lower median household income, a higher percentage of renter households, a lower percentage of college graduates, fewer housing units, and more nonfamily households. These indicators can be taken together and used to explain that the Walksheds area can be more vulnerable to potential displacement and weak stabilization of the neighborhoods. Even though twenty years have passed after the introduction of the Metro Blue line, the overall regions close to the stations are excluded from proper investments for economic development and for realizing socially equitable neighborhoods.

By utilizing the result of the comparison analysis of percentage change in social demographic indicators between the Los Angeles County and twenty-two Walksheds neighborhoods, it is shown that the Walksheds area experienced more neighborhood change in most of social demographic indicators. Especially, social demographic change between 2000 and 2010 was more rapid than the time period during 1990 to 2000. In

particular, in terms of increase of median household income over time, the change in median household income in Walksheds was significantly higher than the county. Moreover, change in housing units are remarkably higher than the county and the change in in-migration was shown better than the county. On the contrary, during 2000 to 2010, the burden of housing expense became heavier in Walksheds area even though there have been huge increase of housing units. Taken together, this reveals that the neighborhoods along the Metro Blue Line experienced displacement or gentrification during the time period studied. Therefore, the neighborhood change in twenty-two Walksheds is negative. For example, households near the station have to pay more than they did in the previous decade for housing expenses. Also, the increased lower income renter households are more vulnerable to displacement in spite of more housing units' development as compared to that of the county.

Therefore, taken together with the comparison analysis results, the primary research questions that were set out for this report can be addressed.

- Is there a significant neighborhood change in terms of the social equity characteristics along the Blue Line corridor?

  Overall, the neighborhoods along the Metro Blue line seem to have considerable neighborhood change over time. Clearly, there has been some neighborhood change in terms of social equity characteristics along the Blue Line corridor. The neighborhoods close to the stations experienced drastically increased housing units over two decades. In terms of share in renter households and percentage of college graduates, the percent change of indicators in twenty-two Walksheds was very small but the change was in a positive way compared to the county. As I expected that the rail line would raise the income of local residents, the median household income became higher than previous time period but the burden of housing cost became heavier at the same time. This reveals that displacement have occurred due to changes in the cost and

availability of housing and having a different demographic profile from previous time period in some Walksheds. However, based on the starting point at 1990, when the rail line began its operation, the overall neighborhoods along the Metro Blue Line still remain disadvantaged and neglected communities as compared to the rest of Los Angeles County.

- If a change exists, has the line played a role as a catalyst in fostering positive neighborhood change in the inner city station areas over time?

  Considering overall neighborhood change in Walksheds along the Metro Blue line, the rail line helped to foster some positive neighborhood change over time in terms of increase in residential development and considerable high increase in median household income in Walksheds. Moreover, comparing percent change in in-migration indicator provides that more in-migration has occurred in Walksheds during the time period, compared to the rest of the region in the county.

- If each station performance varies, which station area has changed the most rapidly over time?

  According to the result, Walksheds located in Downtown LA and Downtown Long Beach experienced rapid change, whether positive or negative. Even though some neighborhoods close to stations in inner city areas have considerably changed over time, most rapidly changed Walksheds exist in core city areas. The Metro Center Walkshed in the City of Los Angeles and Long Beach Transit Mall Walkshed in the City of Long Beach have all shown great change. This reveals that uneven investment has occurred during the time period studied. This may confirm the fact that downtown area has been more attractive to the investment and more vulnerable to displacement as market changes draw new households to station areas.

- Is there any station area that experienced gentrification or displacement?

  Reflecting on the comparison analysis of percent change among the twenty-two Walksheds, gentrification or displacement seems to have occurred over time. Especially when looking at the percent change during 2000 to 2010, the sign of displacement is shown clearer than the previous time period. If there is any gentrification or displacement, in-migrants tend to have a different demographic profile from those who moved out.[42] According to the result of comparison analysis between 2000 and 2010, the change in median household income and housing units is rapidly increased in the Walksheds. Moreover, slight change in social demographic characteristics of Walksheds has been observed in terms of family structure and percent of college graduate. Considering increase of median gross rent as a percentage of household income, the region close to the Metro Blue line has experienced displacement over time.

Even though this report figure out some clue of displacement and gentrification in the selected neighborhoods along the Metro Blue line, more research will be necessary to find the clear patterns of displacement during the time period. For further study, comparing panel data on individual households in the neighborhoods will help to figure out whether there exist a pattern of change in which residents are involuntarily forced to move out because they cannot afford to stay in the neighborhoods. Moreover, diversifying social demographic indicators enables the research for displacement in depth. Last, connecting with the local plan for the station area will be accompanied to the result of analysis in order for better understanding of particular neighborhood change in the local context.

To conclude, the Metro Blue line positively affected the neighborhoods in the vicinity of the rail line over time. At the same time, the result reveals that some of neighborhoods close to the rail line experienced displacement. Moreover, while some

[42]Metropolitan Area Planning Council (2014) *The dimensions of displacement: Baseline Data for Managing Neighborhood Change in Somerville's Green Line Corridor*.

positive neighborhood change has occurred in the Walksheds, the area still tends to be located in the City's lower income areas, so making equity a key priority in future citywide TOD strategy. In fact, it can be seen as a failure to meet the goal of maximizing equity and fostering greater opportunities for upward economic mobility, since it accelerated unbalanced development between twenty-two station areas according to the result and most of neighborhoods along the rail line corridor still remains as the most marginalized neighborhoods in Los Angeles County.

This result implies that the uneven investment among twenty-two Walksheds and the failure of realizing its fostering social equity is a result of the improper planning of the Metro Blue line from the beginning. While the rail line opened in 1990, the plan of development strategies along the Metro Blue line came out in 1996.[43] Moreover, the project areas only focused on four Blue Line stations in the unincorporated communities in South-Central Los Angeles. According to the *Blue Line Transit Oriented Districts Study*, the plans are made to encourage transit supportive development such as mixed uses and greater pedestrian orientation. However, there is a lack of ways to prepare when unwanted neighborhood change occurs in terms of social equity impacts from the rail line. In fact, based on the result of this research, the plan did not work as a catalyst for boosting economic mobility since the performance of target stations was not outstanding in this analysis.

Alternatively, the reason for uneven investment along the rail line can be found in the originally devastated landscape and lack of community involvement and participation. Most of station areas in inner cities are surrounded by underutilized industrial land and vacant parcels so it was not attractive to induce the investment of the area. According to the previous research on the Metro Blue Line, the Metro Blue Line represents a failure of ideal transit oriented development because of its missing antecedents for community and

[43] Land Use and Economic Development Strategies, Blue Line Transit Oriented Districts Study, http://planning.lacounty.gov/assets/upl/data/ord_green-line-tod-Land-Use-Economic-Blue-Line-TOD-Study.pdf (Accessed August 11, 2014)

lacking pre-conditions in order to restructure the urban form.[44] Moreover, the previous research contends that the ultimate reason of this failure is that the Metro Blue Line was not planned to serve economically disadvantaged communities who have lived there for a long time and are likely to become potential core-riders of transit. Reflecting on the lesson from the Metro Blue Line case through this report, inclusive planning should be considered before a new transit system is planned, and planners, policymakers and advocates should try to shape more equitable patterns of neighborhood change.

[44]Loukaitou-Sideris A. and Banerjee T. (2000) "The Blue line Blues: Why The Vision of Transit Village May Not Materialize Despite Impressive Growth in Transit Ridership", *Journal of Urban Design*, Vol. 5, pp.101-125

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